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STEINHAUS (E. A.). **Principles of Insect Pathology.**—$9\frac{1}{4} \times 6\frac{1}{4}$ ins., xi+757 pp., 219 figs., many refs. New York, N.Y. & London, McGraw-Hill Book Co., Inc., 1949. Price $8 or 68*s*.

The bulk of this text-book on disease in insects, mites and ticks, notably honey bees, silkworms [*Bombyx mori*, L.], and injurious insects, is concerned with infection by agents pathogenic to them, but two chapters are devoted to the pathological effects of mechanical and physical injuries, poisoning, parasitism or infestation by other insects or mites, and faulty nutrition and metabolism, and two others comprise a descriptive account of the fauna and flora found in or on or associated with healthy insects. General information on the nature, causes and spread of infectious diseases among insect populations and the properties of resistance and immunity and their origins is contained in two chapters, and specific diseases caused by bacteria, fungi, viruses, protozoa, and nematodes and other parasitic worms are dealt with in five others. The information on the diseases varies in scope according to existing knowledge, but includes accounts of the work done on them, their symptoms, the properties and systematics of the organisms responsible with methods for their culture, the use that has been made of the diseases in controlling injurious insects, and the treatment prescribed for them in beneficial ones. General aspects of the use of pathogenic organisms in the control of insect pests are discussed in a concluding chapter.

EBELING (W.). **Subtropical Entomology.**—$11 \times 7\frac{1}{2}$ ins., ix[+1]+747 pp., 575 figs., 20 maps., 10 portr., $34\frac{1}{2}$ pp. refs. San Francisco, Calif., Lithotype Process Co., 1950. Price $7.50.

The subject matter of this text-book on the animal pests, chiefly insects and mites, that attack subtropical fruits is based on a course for students of subtropical horticulture in California, but much of the information is applicable to similar regions in other parts of the world. Rather more than half of the book is devoted to general aspects of entomology and pest control, including the morphology, development, classification and identification of insects, entomological organisations and legislation in the United States, biological control, artificial control methods, with special emphasis on those most utilised on subtropical fruit crops, the chemistry, toxicology and formulation of insecticides, the equipment available for their application, and the design of experiments for their evaluation. The rest of the book contains information on the appearance, bionomics and control of specific pests arranged according to their food plants. Pests of *Citrus* in the United States and in other countries are dealt with in separate chapters, and other chapters are concerned with pests of grape vine, walnut, almond, pecan, fig, olive, avocado, date and fruits of minor importance and include notes on pests of the dried fruits. The book is illustrated with numerous photographs.

KALSHOVEN (L. G. E.). **De plagen van de cultuurgewassen in Indonesië. Deel I.** [The Pests of Cultivated Plants in Indonesia. Part I.]—$9\frac{1}{2} \times 6\frac{3}{4}$ ins., 512[+7] pp., 8 col. pls., 298 figs., many refs. The Hague, W. van Hoeve, 1950. Price 33.75 *gld*.

This comprehensive monograph on the animal pests of plants and plant products and their natural enemies in Indonesia is the first on the subject to appear since those of Dammerman [*R.A.E.*, A **8** 360 ; **17** 233] and is based largely on the numerous published and unpublished records of the various Experiment Stations in the area. It is arranged systematically and is to consist of two volumes, of which this, the first, contains the sections on worms

(with a chapter on the eelworms of plants by J. van der Vecht) and molluscs, and on the Arthropods, except some of the Lepidoptera, and the Coleoptera, Hymenoptera and Diptera, which, with the birds and mammals, are to be included in the second volume. The information given on the individual species varies in scope and degree of detail according to the status of the species concerned and includes their morphology, distribution, bionomics, food-plants or other food, economic importance and control, with mention of natural enemies and plant diseases, if any, transmitted by them. Each section contains its own bibliography, with references to local records. The numerous illustrations, both coloured and otherwise, form a valuable addition.

LIEU (K. O. V.). **The Study of Wood Borers in China—II. Biology and Control of the Citrus-trunk-Cerambycids,** *Nadezhdiella cantori* **(Hope) (Coleoptera).**— *Notes Ent. chin. Mus. Heude* **11** fasc. 2 pp. 69–119, 30 figs., 1 fldg. table, 21 refs. Shanghai, 1947.

This paper of a series on Longicorns of *Citrus* in Szechwan [*cf. R.A.E.*, A **34** 270] contains an account of investigations carried out in 1939–43 on the bionomics and control of the Cerambycid, *Nadezhdiella cantori*, Hope, which attacks the trunks [*cf.* **32** 19]. All stages are described. The egg, larval, pupal and pre-emergence stages usually lasted about 2–12 days, 20–23 months, 21–33 days and 12–23 days, respectively, the adults lived for about one month after emergence and the life-cycle was normally about two years. In some cases, the life-cycle lasted three instead of two years, the third winter being passed in the pre-emergence stage.

The eggs are laid between late May and late July, usually singly, in crevices on the bark of the trunk and main branches. The larvae feed on the inner bark for about six weeks before entering the wood. They are active for about 4½–5 months before hibernating for 4½ months and for about 4½–7 months of the second year before hibernating again for 5–9 months. Although the total length of the larval tunnel is only about two feet, it interrupts the flow of water and food in the tree. Both the fecundity and the percentage hatch are very high, and there are frequently several larvae in a single tree, with the result that it is killed. Pupation takes place in a small branch of the main burrow. Most adults emerge in June or July, though a few appear in May or August. They often spend some time in the larval burrow and were observed pairing in large excavations made for emergence. They hide during the day and fly at dusk. Captured females deposited a maximum of 57 eggs each, but field-collected females contained 100–150 mature eggs.

N. cantori is widely distributed in the *Citrus*-growing districts of all the Chinese provinces to the east and south of Szechwan and in Formosa, and the larvae were collected from the trunks of several species of *Citrus*. No parasites were found, but the larvae were attacked by ants and wasps.

As a result of the investigation, various control measures are recommended. Adults should be collected between late May and early August, before the dew disappears, particularly from big holes in the lower portions of the trunks. The trunks should be examined to a height of about eight feet for eggs and for exudations of fine wood-dust five times in June and July, and the eggs removed with a hard brush or by hand and the young larvae killed by rapping on the bark at points where frass is seen. The trunks can also be brushed clean and then whitewashed with a freshly made mixture of quick-lime and water (1 : 6) during hot sunshine in early June, which was found to discourage oviposition. Badly damaged trees should be cut down and sawn into short lengths and split, and the insects in them killed.

Broekhuysen (G. J.). **The Brown House Ant** (*Pheidole megacephala*, **Fabr.**) **in South Africa.**—*Bull. Dep. Agric. S. Afr.* no. 266, [1+]40 pp., 1 pl., 22 figs., 40 refs. [Pretoria, ? 1947.]

A detailed account is given of investigations during 1940-41 on the bionomics and control of *Pheidole megacephala*, F., which is a troublesome pest in some parts of South Africa, notably the Transvaal and parts of the Orange Free State, because it enters houses in numbers and also damages lawns by uprooting the grass in constructing its nests during spring and summer. The nests are made in soil at the base of trees or the walls of buildings and under stones or in compact soil, usually not more than five inches below the surface and often crowded together. Monthly observations were made on nests in a suburb of Pretoria, but the same nest could not be examined repeatedly, as the ants moved away when it was disturbed, possibly because of their sensitivity to changes in temperature and moisture. Eggs and young larvae were abundant in July–September, but worker pupae were very scarce then, though they were numerous during summer ; the retardation of development during winter is probably due to the combined effects of drought, low temperatures and food scarcity. Larvae of the fertile castes appeared at the beginning of October and the pupae were found in October and November. Winged adults were observed during October, November, January and February ; males, which appeared to be very rare, were present only in November and January. The very young immature stages were scarce during November–February. Soldier pupae were abundant during December–January and scarce or absent in the other months. The number of queens in a nest varied from 0 to over 93. Drought sometimes caused high mortality in a colony.

Studies of the effects of temperature on development were made in observation nests, which are described. Solutions of syrup and sugar and pieces of insect provided as food were not eaten, but the adult ants fed on the immature stages, and eggs were reared to the adult stage in only one nest. These studies indicated that the thresholds of development of eggs, worker larvae and worker pupae are 55, 61 and 59°F., respectively. The durations of development at different average daily mean temperatures ranged from 32 to 34 days at 64° to 13 at 77° for eggs, from 29 to 32 days at 73° to about 24 at 75° for worker larvae, and from at least 20 days at 72° to 10 at 78° for worker pupae. The pupal stage of the soldiers occupied about the same time as that of the workers, that of the females lasted 17–21 days at 73–74°, and that of a male 16 days at 73°. The complete development of a worker required 52 days at an average daily mean temperature of 75°, but is probably somewhat shorter in the field. A generation probably requires at least two months to develop under the climatic conditions prevailing at Pretoria, and temperatures there are too low in June–August for the development of eggs, larvae and pupae. Observations on feeding were carried out by means of an automatic photographic apparatus, which is described, that photographed the feeding tray every hour. During two tests in August–September and October–November, the ants fed principally during darkness, but many also fed in daylight during the latter period, which was warmer and more humid. Feeding activity was found to be correlated with temperature. In tests of the attractiveness of poisoned baits, ants in artificial nests were given access to mixtures of 712 gm. golden syrup and 700 cc. water containing 0·4, 2 or 4 gm. sodium arsenite or to a bait composed of 7 gm. tartar emetic, 2 gm. sodium benzoate, 4 gm. tartaric acid, 1,361 gm. sugar and 1,136 cc. water that had given good control of the Argentine ant [*Iridomyrmex humilis*, Mayr] in the Port Elizabeth district. No other food was provided. The ants continued to visit all the arsenical baits in considerable numbers for up to five days, and the weakest one for at least a fortnight. The tartar-emetic bait was attractive for eight days of

observation in one test, but was little attractive on the fifth day in another. Females present in the nest were unaffected by the baits. In a toxicity test, in which workers were confined in a petri dish containing some drops of the bait until they had fed on it and then transferred to a Janet observation nest, the tartar-emetic bait was ineffective. One containing 2 gm. sodium fluosilicate, 0·7 gm. tartaric acid, 0·1 gm. sodium benzoate, 520 gm. honey and 568 cc. water gave 50 per cent. mortality in 12–23 hours when used fresh, but the best results were given by a mixture of 720 gm. golden syrup, 4 gm. sodium arsenite and 700 cc. water, which caused 50 per cent. mortality within five hours and complete mortality within 14. Similar baits containing 2 or 0·6 gm. sodium arsenite were rather less effective. One comprising 1·8 gm. sodium arsenite, 0·6 gm. tartaric acid, 1·2 gm. sodium benzoate, 720 gm. honey and 625 cc. water gave 50 per cent. mortality in 6–20 hours and complete mortality in 22–24 hours, and one of 1·6 gm. sodium arsenite, 1 gm. sodium benzoate, 720 gm. honey and 909 cc. water gave 50 per cent. mortality in 2–13 hours and 97 per cent. in 23–24.

Suggestions for control include the destruction of nests [**30** 88], preferably during winter, when populations are relatively small, and while the sexual forms are developing, and the use of baits as a supplementary measure during winter when natural food is scarce. Other food supplies should be reduced to a minimum, by keeping infested houses scrupulously clean and storing food in cupboards made ant-proof by means of adhesive bands. Contact poisons, such as sodium fluoride, are also of value [**23** 70].

BRIXHE (A.). **Les parasites du cotonnier en Afrique centrale. Tableaux de détermination.**—2nd edn., 184 pp., 109 figs. (12 col.), 4 pp. refs. [Brussels] Compagnie coton. congo., 1949.

This handbook is primarily concerned with the recognition of the Arthropods (mostly insects), fungi and other pathogenic organisms that attack cotton in Central Africa, with special reference to the Belgian Congo, and is composed of four parts, of which the second, comprising a key to the pests based mainly on the part of the plant affected and the nature of the damage, is the largest. A general account of the control methods available against the different kinds of pests is given in the first part, the third contains more detailed information on the damage due to some of the more important pests with, in some cases, notes on their appearance and control, and the fourth deals briefly with the assessment of their relative importance in a crop. The book also includes a table showing the French names of the pests with their scientific, English and Portuguese equivalents.

EASTHAM (L. E. S.) & SEGROVE (F.). **The Influence of Temperature and Humidity on Instar Length in *Calandra granaria* Linn.**—*J. exp. Biol.* **24** no. 1–2 pp. 79–94, 5 figs., 24 refs. London, 1947.

The following is virtually the authors' summary. The effects of temperature and humidity on the duration of each instar of the life-cycle of *Calandra granaria*, L., in wheat were examined [*cf. R.A.E.*, A **32** 81]. The insects were reared at temperatures ranging from 15 to 30°C. [59 to 86°F.] and at atmospheric humidities ranging from 40 to 80 per cent. relative humidity. A method of calculation is described for assessing the effect of temperature as an independent factor. The temperatures employed fall within the " vital zone ". Extrapolation indicates the threshold temperature to be approximately 11°C. [51·8°F.] for the egg and larval instars though somewhat lower for the pupa ; 30°C. is below the optimum temperature. The durations of the egg and pupal stages are not affected by atmospheric humidity. The duration of all larval

instars is affected by moisture. It is suggested that this is largely due to atmospheric humidity and that food water is of little significance. Shortage of moisture acts as an obstacle to development. Evidence is presented indicating that drier atmospheres tend to desiccate the insect and that desiccation is responsible for retarded growth and development. Since much earlier work on temperature and moisture has been done on fasting insects and, therefore, on insects deficient in one of the most important environmental factors, the authors suggest that their results, though incomplete, indicate the need for new approaches to be made. More complete data on feeding insects under controlled conditions of food, temperature and moisture are required, from which can be drawn up more complete balance sheets of development involving measurements of food utilisation and respiratory rates.

CROMBIE (A. C.) & DARRAH (J. H.). **The Chemoreceptors of the Wireworm (*Agriotes* spp.) and the Relation of Activity to chemical Constitution.**— *J. exp. Biol.* **24** no. 1–2 pp. 95–109, 4 figs., 20 refs. London, 1947.

The following is virtually the authors' summary. This paper continues work on the responses of wireworms (*Agriotes* spp.) to chemical stimulation [*R.A.E.* A **37** 402] by a further analysis of the relation of activity to chemical constitution and of food finding, and the investigation of the anatomy and physiology of the chemoreceptors. Substances present in food plants elicit two responses, orientation and biting [*loc. cit.*]. There is a clear distinction between those compounds that cause only orientation and those that cause both biting and orientation. In almost every case the former have high activities (9–11) whereas the latter have activities of less than 3, activity being defined as minus the logarithm of the threshold concentration expressed as gm. /ml. All the biting compounds tested for orientation have proved active, the threshold being similar to that for biting. Substances causing orientation fall into two classes, namely amides and urea derivatives, and dicarboxylic acids. In view of the small number of compounds tested, the two classes of active substances should be treated with reserve. In the first, it seems definite that the amide group is responsible for activity, but whereas all the other compounds found to be active are dicarboxylic acids, it is by no means true that all dicarboxylic acids are active, and no rule is apparent for predicting whether a given dicarboxylic acid will be active or not. Substances causing both orientation and biting summate when either response is tested. The following pairs of substances summated when tested for the response indicated ; glucose and sucrose for orientation and biting ; glucose and peptone, glucose and triolein, peptone and triolein and glucose and tannin for biting.

Orientation occurs in a gradient of concentration of which the steps are formed by different substances, as well as when the steps are formed by one substance. Active substances are secreted in small amounts by the roots of growing potato plants. These would explain the orientation of wireworms to the roots of growing plants such as wheat. It is thus likely that the root system forms an extended trap along which wireworms may be led to the grain or tuber in the centre, where a wound caused by their random biting would release active compounds in sufficient concentration for them to remain and feed. The biting of glucose is inhibited by lead acetate, quinine, allyl-isothiocyanate or common salt, as well as by acid and alkaline solutions. Common salt also inhibits orientation in glucose, but not in asparagine. The chemoreceptors that appear to be involved in these responses are of two kinds : peg organs, located on the labial and maxillary palps and galeae, whose stimulation leads to both orientation and biting ; and a cup-shaped sensilla on the distal segment of each antenna, whose stimulation leads to orientation only. Both asparagine and glucose stimulate both kinds of receptor.

Schread (J. C.) & Chapman (G. L.). **Control of Ants in Turf and Soil.**—*Bull. Conn. agric. Exp. Sta.* no. 515, 23 pp., 6 figs., refs. New Haven, Conn., 1948.

Some of the tests described in this account of experiments in Connecticut on the control of various ants by means of chlordan have already been noticed [*R.A.E.*, A **37** 395–396]. It was also tested against *Lasius niger neoniger*, Emery, tending Aphids that were abundant on the roots of chrysanthemums, 4 oz. 50 per cent. wettable chlordan powder in 50 U.S. gals. water per 75 ft. of row being applied as a coarse spray to the soil round the roots in August. The Aphids and 93 per cent. of the ants were killed within 48 hours, and by October, when the plants were in bloom, little evidence of injury due to the Aphids was visible. The lower leaves on a few of the plants were slightly scorched. Colonies of *Camponotus herculeanus pennsylvanicus*, Deg., established in old apple and cherry trees and in the foundation of a house were successfully controlled by applications of chlordan powder.

Garman (P.). **Mite Species from Apple Trees in Connecticut.**—*Bull. Conn. agric. Exp. Sta.* no. 520, 27 pp., 22 figs., refs. New Haven, Conn., 1948.

During investigations on *Paratetranychus pilosus*, C. & F., on apple in Connecticut, collections were made of all the mites that occurred on the trees. Lists are given of some 30 species found, of which at least seven were plant feeders, at least 13 predacious and the rest scavengers or of doubtful habits. The only serious pests were *P. pilosus*, which is consistently of importance, and *Tetranychus bimaculatus*, Harvey, which has become increasingly injurious since the use of DDT by growers. The predators described include *Gamasellus americanus*, *Iphidulus fallacis* [*cf.* next abstract], *I. conspicuus*, *Seiulus bakeri* and *Amblyseius* (*Amblyseiopsis*, subgen. n.) *americanus*, all of which are new species, and *I.* (*Seiulus*, *Seius*) *pomi*, Parrott. Notes are given on the characters and scope of some of the genera, and a new subfamily is erected for one of them.

Lord (F. T.). **The Influence of Spray Programs on the Fauna of Apple Orchards in Nova Scotia. III. Mites and their Predators.**—*Canad. Ent.* **81** nos. 8–9 pp. 202–214, 217–230, 9 refs. Guelph, Ont., 1949.

This part of a series dealing with long-term investigations of the effects of sprays on the Arthropod fauna of apple orchards in Nova Scotia [*R.A.E.*, A **38** 5, etc.] is devoted to studies on mites, notably *Paratetranychus pilosus*, C. & F., and *Bryobia praetiosa*, Koch, and the mites and insects that prey on them. Observations were made in commercial orchards sprayed with fungicides for the control of apple scab [*Venturia inaequalis*], in experimental plots sprayed with various insecticides and in the laboratory. The substitution of iron carbamate (ferric dimethyl dithiocarbamate) for sulphur in those sprays of a sulphur schedule against apple scab that are applied during the flowering period facilitated the natural control of *Lepidosaphes ulmi*, L., in commercial orchards [*cf.* **36** 392], but interfered with that of *P. pilosus*. Where only copper fungicides (bordeaux mixture or copper oxychloride sulphate) were used, this mite became of minor importance after the first year, and was subsequently held in check by natural enemies. *B. praetiosa* is controlled by sulphur, and though it may become of minor importance in orchards sprayed with iron carbamate or with copper fungicides, it is largely controlled in them by its natural enemies. *Tetranychus bimaculatus*, Harvey, has never been a pest of apple trees in Nova Scotia, but occasionally occurs in small numbers on them in autumn.

H. H. J. Nesbitt recently observed several closely related species of predacious mites on apple trees in the Annapolis Valley. They do not include *Iphidulus* (*Seiulus*) *pomi*, Parrott, as described by Garman [*cf.* last abstract], which has not been found in Nova Scotia, though they were formerly confused under the name *Seiulus pomi* [*cf.* **23** 701], and the common species is the one described by Garman as *I. fallacis* [*cf.* last abstract]. On comparing it with the type of *I.* (*Typhlodromus*) *tiliae*, Oudm., however, Nesbitt concluded that *I. fallacis* is a synonym of *I. tiliae*. This mite feeds readily on Eriophyids and has been observed to attack the active forms of *Tydeus robustus*, Banks. It appears to be the most important predator of *P. pilosus*, but probably attacks the eggs of most mites, though it does not feed readily on those of *Bryobia praetiosa*. It often increases suddenly during late summer on trees that have been sprayed with materials deleterious to it, probably as a result of migration from the ground or from low-growing plants. In small-scale tests, sprays of 1 gal. summer oil or 1 lb. DDT per 100 gals. were very toxic, nicotine sulphate and a new experimental fungicide, dichlornaphthoquinone, showed some adverse effects, which were delayed in the case of the latter, and lead arsenate, synthetic cryolite and fixed nicotine were harmless ; in commercial orchards, both flotation sulphur and iron carbamate were toxic, but Bordeaux mixture was not [*cf.* **23** 701].

Spray materials that are harmless to *I. tiliae* have, in general, little effect on other predators of *P. pilosus*, which are more sporadic in occurrence. *Haplothrips faurei*, Hood, which is an important factor in natural control, is apparently repelled or destroyed by sulphur, but is usually abundant in late autumn where *P. pilosus* is numerous ; it may become plentiful at any time during the growing season if the numbers of the mite are sufficiently high and no deleterious sprays are being used. A. W. MacPhee found that there were three overlapping generations each year ; the winter is passed in the adult stage, but no adults were found on the trees during winter. Much of the mortality among overwintering eggs of *Paratetranychus* that was formerly attributed to *I. tiliae* [**23** 701] is believed to be due to this thrips. It also feeds on the eggs of *B. praetiosa*, and MacPhee states that it fed on the eggs of *Spilonota ocellana*, Schiff., in the laboratory. A spray programme of Bordeaux mixture and iron carbamate with the addition of nicotine sulphate had little effect on the thrips in one orchard, and in another in which lead arsenate replaced the nicotine sulphate, its numbers decreased with those of *P. pilosus*. Copper fungicides had little adverse effect, but it was very scarce in orchards in which DDT was incorporated into a programme of Bordeaux mixture and iron carbamate. Other predacious thrips that fed on eggs of *P. pilosus* and, in the laboratory, of *B. praetiosa*, were *Leptothrips mali*, Fitch, *Haplothrips* (*Zygothrips*) *americanus*, Hood (*minutus*, auct.) and *Scolothrips sexmaculatus*, Perg. *L. mali* was moderately abundant in commercial orchards sprayed with Bordeaux mixture and iron carbamate, and in one that received post-bloom applications of nicotine sulphate and fixed nicotine. *H. minutus* occurred mainly in orchards that had received only copper fungicides, but is of little importance owing to its small numbers. It is apparently destroyed by extreme cold.

Mediolata novae-scotiae, Nesbitt [**35** 411] feeds on the eggs of *B. praetiosa* and is one of its more important predators, but cannot control it unaided. It seized Eriophyids and *Czenspinskia lordi*, Nesbitt [**35** 411], a fungus feeder that occurs only on trees that have not been sprayed for some years, but it apparently does not feed readily on eggs of *P. pilosus*. It is common, though never numerous, on neglected trees and was present in fairly large numbers in a few orchards in which copper compounds were the only fungicides. Both *B. praetiosa* and *M. novae-scotiae* were more numerous on trees sprayed with

copper than on neglected ones. *M. novae-scotiae* disappeared from orchards sprayed with flotation sulphur, possibly because the sprays destroyed the mites on which it feeds. Iron carbamate was very injurious to it, but lead arsenate and synthetic cryolite were not.

Anystis agilis, Banks [*cf.* **23** 702] is a general predator on mites and small insects and its value against any one probably depends on their relative abundance. There are two generations a year. Nesbitt found that the eggs are laid in the soil, and the larvae migrate to the trees ; this explains their ability to become numerous in late summer in orchards sprayed with toxic materials. This mite is scarce in commercial orchards ; its numbers are greatly reduced by lead arsenate, and flotation sulphur appeared to destroy or repel it. The increased populations of *P. pilosus* and *B. praetiosa* in orchards in which lead arsenate was used were probably due in part to the destruction of *A. agilis*. Iron carbamate and copper fungicides had little effect on it, and synthetic cryolite and nicotine sulphate appeared to be only slightly toxic.

Other predacious mites in orchards that had not been sprayed or subjected to cultural practices for some years, in which numbers of *P. pilosus* were usually low, included *Eupalus parvus*, Ewing, *E. biscutum*, Nesbitt, *Cunaxa* sp., *Cyta latirostris*, Herm., and a species of *Atomus*. Several small spiders attack the active forms of *P. pilosus* in such orchards but are of very minor importance in commercial ones.

Several Mirids were found to attack the eggs of *P. pilosus* in orchards [*cf.* **23** 701] but *Diaphnidia pellucida*, Uhl., *Hyaliodes harti*, Knight, and *Campylomma verbasci*, H.-S. [*cf.* also **28** 430], were the only ones of importance. They are effective against *P. pilosus* and probably also *B. praetiosa* from early June until the latter part of July, and are often the only important predators present in commercial orchards, from which it is concluded that Bordeaux mixture and flotation sulphur are not toxic to them. Tests indicated that fixed nicotine and DDT are toxic, whereas iron carbamate and synthetic cryolite are practically harmless. The Anthocorids, *Orius insidiosus*, Say, and *Anthocoris musculus*, Say, are fairly important predators where they are sufficiently numerous, and several unidentified Chrysopids are often important in autumn in destroying the overwintering eggs of *P. pilosus*. Both groups of insects are among the first predators to appear in autumn in orchards that have been treated with DDT. Various Coccinellids fed on eggs of *P. pilosus* in the laboratory, but the only one of any importance in the field is a species of *Scymnus*, and it is rarely abundant enough to exert any considerable control.

FREEMAN (T. N.). **The Identity of** *Malacosoma fragile* **(Stretch) and** *M. lutescens* **(N. & D.) (Lepidoptera : Lasiocampidae).**—*Canad. Ent.* **81** no. 9 p. 233. Guelph, Ont., 1949.

A Lasiocampid that occurs as a pest on rose, cherry and gooseberry in Canada from southern Manitoba to the foot-hills of Alberta has been considered to be *Malacosoma fragile*, Stretch, but examination of Stretch's type showed that it differed from it in colour. It was identical with the type of *M. fragile* var. *lutescens*, Neum. & Dyar, to which the author accords specific rank.

BALDWIN (W. F.) & COPPEL (H. C.). **The Biology of** *Phorocera hamata* **A. & W., a Tachinid Parasite of Sawflies.**—*Canad. Ent.* **81** (1949) no. 10 pp. 237–245, 16 figs., 8 refs. Guelph, Ont., 1950.

An account is given of the bionomics of *Phorocera hamata*, Aldr. & Webber, which was found parasitising the pine sawflies, *Neodiprion lecontei*, Fitch, *N. banksianae*, Rohw., and *N. nanulus*, Schedl, in Ontario and has been recorded from other sawflies [*R.A.E.*, A **12** 214 ; **33** 223]. Field and laboratory studies

of this Tachinid, of which the immature stages and the reproductive organs of both sexes are described, indicated that it has one generation a year in the field ; adults emerged continuously throughout June and July from collections of *N. lecontei* and were present in the field from June till September, when the larvae of *N. lecontei* are normally on the trees. Laboratory observations on the development were made at a temperature of 23°C. [73·4°F.] and a relative humidity of 60 per cent. The parasite was readily reared on diapausing larvae of *N. lecontei* that had been removed from their cocoons. The adults, of which females comprised 56 per cent., survived for an average of 34 days in the laboratory. They mated readily, and the females oviposited six and a half days, on the average, after emergence. The average number of eggs deposited by each was 47·5, though one laid 393. The egg was deposited in a fold in the integument of the host. The larva hatched after about 48 hours and entered the host, where it formed a respiratory funnel. There were three larval instars ; first-instar larvae were most numerous in hosts that had been parasitised for up to seven days, second-instar larvae in hosts parasitised for 7–12 days and third-instar larvae in hosts parasitised for 13 days or more. After completing part of the third instar, the larva left the funnel and moved about within the host, feeding on the remaining tissues. When full-fed, it left its host and formed a puparium. The larval and pupal stages lasted about 15 and 18 days, respectively. Under laboratory conditions, 36 per cent. of the larvae formed puparia, and adults emerged from 92 per cent. of the latter. In the field, the larvae overwintered in the second instar and pupated in the host cocoons [*cf.* **38** 7]. Individual hosts containing larvae in various stages of development were found, but more than one parasite never matured in a single host when larvae were superparasitised in the laboratory.

During a serious outbreak of *N. lecontei* at Actinolite, Ontario, in 1943, 14·4 per cent. of the sawflies were parasitised by Tachinids, 2·3 per cent. by Ichneumonids, and 9·32 per cent. by Chalcidoids ; *P. hamata* was considered to be responsible for 11·4 per cent., but the original parasitism by this Tachinid was reduced by the hyperparasite, *Perilampus hyalinus*, Say, which often attacks it.

Barter (G. W.) & Brown (W. J.). **On the Identity of *Agrilus anxius* Gory and some allied Species (Coleoptera : Buprestidae).**—*Canad. Ent.* **81** (1949) no. 10 pp. 245–249, 1 fig. Guelph, Ont., 1950.

Agrilus anxius, Gory, has been reported to breed in many species of birch (*Betula*) and poplar (*Populus*) but examination of examples collected in New Brunswick and of specimens in the Canadian National Collection and the U.S. National Museum showed that males from birch and poplar could be separated by their genitalia. Moreover, S. G. Smith found that males and females from birches in New Brunswick have 22 chromosomes whereas those from poplars have 20, and it is concluded that two species have hitherto been confused. As the type specimen of *A. anxius* cannot be found, it is proposed that this name should be retained for the species on birch, and the one on poplar is here described as *A. liragus*, sp. n. The couplets of Fisher's key relating to *A. agrilus* and *A. pensus*, Horn, are modified to include it. *A. anxius* occurs from Newfoundland to British Columbia, extending southwards to New Jersey, Ohio and Colorado, and *A. liragus* from New Brunswick to British Columbia and southwards to Pennsylvania and Arizona. Adults of *A. pensus* have been recorded from alder (*Alnus*) and hornbeam (*Ostrya virginiana*) ; it probably breeds in alder and is known from localities in the north-eastern United States and Nova Scotia, New Brunswick, Quebec, Ontario and Manitoba. *A. torpidus*, Lec., *A. horni*, Kerr., and *A. gravis*, Lec., are provisionally considered synonyms of *A. anxius*, though some records of them refer to *A. liragus*.

During studies of *A. anxius* and *A. liragus* in New Brunswick, the larval galleries in white birch (*Betula papyrifera*) were found to be typically of a zigzag or winding form, whereas galleries made by larvae in the earlier instars in aspen (*Populus tremuloides*) were compact, especially in the more thrifty trees. Galleries resembling the former type were sometimes found in aspen, but compact galleries did not occur in birch. Emergence records from caged logs showed that adults of *A. liragus* began emerging 6–16 days earlier than those of *A. anxius*, and that the mean dates of emergence were 8–20 days earlier and the period of emergence shorter. In the field, adults of *A. liragus* were attracted to logs 10–14 days earlier than those of *A. anxius* and ceased activity 8–19 days earlier. When mated females of *A. anxius* and *A. liragus* that had been reared in the laboratory were caged with logs of both trees or of only aspen and only birch, respectively, they showed a marked tendency, especially in the case of *A. liragus*, to oviposit in logs of the kind from which they had been reared. Interspecific mating occurred in the laboratory, but no evidence of it was found in the field.

BEARD (R. L.). **Time of Evaluation and the Dosage-Response Curve.**—*J. econ. Ent.* **42** no. 4 pp. 579–585, 10 figs., 10 refs. Menasha, Wis., 1949.

In comparing insecticides, the validity of the comparison depends on the precision with which the effectiveness of each insecticide is characterised in equivalent terms. Apart from the physical factors entering into the insecticidal formulation and details of testing, both the killing dose and the time required to kill are important features. These characteristics are seldom considered together, and the author discusses the loss in value of comparisons that results. The following is based on his summary.

Selected data show that the form of a compound curve relating the dosage and mortality and the position and slope of simple curves may change with differences in the time of evaluation after insecticidal treatment. The importance of these changes lies in the fact that misleading conclusions may be drawn regarding the performance of compounds in comparative studies if time of response is not taken into consideration. Methods of graphically representing the three variables of dosage, response time and mortality are illustrated and discussed, and the desirability is indicated of a mathematical treatment that will permit quantitative discrimination between toxicants and take into account the several qualifying factors.

SMALLMAN (B. N.). **Residual Action of Low Vapour Pressure Fumigants.**—*J. econ. Ent.* **42** no. 4 pp. 596–601, 3 graphs, 3 refs. Menasha, Wis., 1949.

Fumigants are commonly applied to local portions of a bulk material or to individual machines in a large space, but little attention has been paid to the type of fumigant required. Local application of a highly volatile fumigant in milling machinery achieves only a transitory insecticidal effect, because the fumigant is rapidly lost from the semi-open space and reinvasion by insects commonly occurs. Fumigants of low vapour pressure and high toxicity would be expected to remain effective longer, and they were shown to do so in tests of a series of fumigants of different vapour pressures applied to flour in open vessels. The requirement that the fumigant should be readily removed from the stock by aeration is of minor concern, since the accumulations of cereal that tend to become infested are presumed to remain in the machines without mixing with the moving mill stream.

Seven fumigants known to be highly toxic to insects and having a wide range of vapour pressures were tested by putting 2 ml. on blotting paper in the bottom of an open beaker, which was then filled with 375 gm. flour to a depth

of three inches. All the fumigants were liquid at room temperature except γ BHC (benzene hexachloride), which was applied as a 40 per cent. solution in acetone. Caged adults of *Tribolium confusum*, Duv., were put in the flour for four days at various intervals, both flour and insects being prevented from coming in contact with the unvaporised fumigant. Of the materials tested, acrylonitrile, chlorpicrin, ethylene dibromide and hexachlorpropene (with vapour pressures of 117, 24, 13·5 and 0·3 mm. mercury at 25°C.) gave complete mortality for 1, 2, 12 and 66 days and at least 50 per cent. for 2, 2, 20 and 172 days, respectively, dichlorethyl ether (3 mm.) gave at least 50 per cent. total mortality for 28 days but never gave complete mortality of insects near the surface of the flour, symm.-heptachlorpropane (0·1 mm.) gave complete mortality for 112 days (up to the end of the experiment) and at least 50 per cent. for 176 days, and γ BHC ($2{\cdot}1 \times 10^{-5}$ mm.) did not give 50 per cent. mortality during the 50 days for which it was tested. The fumigants with high vapour pressures became effective rapidly, but hexachlorpropene and symm.-heptachlorpropane did not begin to give complete mortality until 23 and 88 days, respectively, after they were applied.

When the beetles were caged for one to four days in flour that had been exposed over hexachlorpropene for various periods, there was no mortality in freshly treated flour for exposures of up to three days, but appreciable mortality after four days' exposure ; this occurred almost entirely in the lower half of the vessel. Mortality increased with increasing exposure of the flour to the fumigant, until, after 35 days, beetles kept in the flour for only one day suffered 88 per cent. mortality. Insects exposed for four days near the free surface of the flour generally showed lower mortalities than those deep in the flour. Those in the lower half of the flour showed complete mortality throughout the entire period, of about 170 days, but complete mortality near the surface was not achieved until about 30 days after exposure of the flour, and the toxic effect showed a slow decline after a further period of 66 days. During the period of optimum mortality, the hexachlorpropene appeared to be effective at a depth of only 0·375 inch below the surface of the flour. When a strong current of air was driven over the surface at a distance of one foot, complete mortality near the surface was achieved eight days sooner than without aeration, presumably because air currents set up in the flour accelerated the normally slow diffusion of the hexachlorpropene vapours. After the mortalities once became equal, no appreciable difference in mortality due to aeration was observed until the experiment was terminated after 105 days. When beetles were released on the surface of the flour over a 2 ml. deposit of hexachlorpropene, there was no marked tendency for them to remain on the surface. It seemed likely that insects that burrowed under the surface and remained there for some time were killed, whereas those that remained at or near the surface survived. To determine whether the insects were killed by fumigation or by ingesting flour particles on which toxic residues were adsorbed, beetles were placed in flour that had been exposed over hexachlorpropene for 20 days or in the air space above it in a closed vessel. After exposure for 4–24 hours, there was no significant difference in mortality between insects in and above the flour, indicating that those exposed in the flour were killed by the free vapour present in the interstitial air spaces.

The marked increase in duration of toxic effect for fumigants of low vapour pressure does not follow directly from the slower rate of volatilisation and the maintenance of a reservoir of unvolatilised fumigant for considerable periods. Other factors involved include slow diffusion associated with high molecular weight (247 for hexachlorpropene) and the tendency for fumigants of low vapour pressure to be strongly adsorbed on cereal products. With fumigants of high vapour pressure, the processes of volatilisation, diffusion, adsorption

and subsequent desorption take place rapidly, so that considerable quantities must be applied if the insects are to be exposed to a toxic concentration for even short periods. With fumigants of low vapour pressure, these processes are retarded, so that a relatively small quantity of a highly toxic material will keep the flour under continuous fumigation for a considerable period. The results obtained with BHC suggest a limit at which the retarding effects of slow volatilisation and diffusion and adsorption on the flour are so great that long periods are necessary to produce a toxic vapour concentration.

GINSBURG (J. M.), FILMER (R. S.), REED (J. P.) & PATERSON (A. R.). **Recovery of Parathion, DDT and certain Analogs of Dichlorodiphenyl-dichloroethane from treated Crops.**—*J. econ. Ent.* **42** no. 4 pp. 602–611, 30 refs. Menasha, Wis., 1949.

The following is largely based on the authors' summary. Chemical analyses of DDT, DDD (dichlordiphenyldichlorethane), methoxy-DDT (methoxychlor) and parathion were made on several sprayed and dusted vegetable crops in order to study the residues left on the plants at harvest in New Jersey and their possible translocation or absorption into edible plant tissues. The crops were grown in the field, in experimental plots or on commercial farms, and the insecticides were applied for practical insect control, though only the results of the chemical analyses are discussed in this paper. Samples of the plants were collected before and during harvest, dried in a shaded greenhouse and extracted with benzene, after which the solvent was evaporated and the residue analysed for the toxicants.

DDT residues were determined on lucerne treated with 3 and 1 per cent. DDT dusts, on maize stalks dusted 4–5 times with 3 per cent. DDT and on pea plants sprayed at the first blossom stage with 1 lb. DDT per acre. Residues of DDD and methoxy-DDT were analysed on lucerne dusted with 3 and 5 per cent. of the toxicants, respectively, and those of parathion on pea plants receiving 0·5–1 per cent. dusts or sprays containing 0·25–1 lb. toxicant per acre, maize stalks receiving 0·5–1 per cent. dusts and lucerne treated with 0·5 per cent. dust. Shelled peas and maize kernels were analysed for translocation of DDT and parathion, and absorption of parathion was also determined in potato tubers grown in soil treated with 5, 10 and 20 lb. parathion per acre.

The results showed that, except when the plants were harvested on the day of treatment or when no rain had fallen, the residues from the three chlorinated insecticides on all crops tested were equivalent to 0–4 parts per million of toxicant based on green weight. In general, higher amounts were found on lucerne than on maize stalks or pea plants. Although the amount of rainfall had a definite effect on the amount of toxicant recovered at harvest, the relationships were not always proportional, and other factors such as plant growth and variety evidently had some effect. In the absence of rain, high deposits (19 p.p.m.) of DDT were recovered from dusted maize stalks. About 0·4 p.p.m. DDT was found in one sample of shelled peas from plants sprayed with 1 lb. DDT per acre when in flower, but none was present in maize kernels from plants dusted four times with 3 per cent. DDT. Residues of DDD and methoxy-DDT at harvest were 0–0·32 and 0–3·5 p.p.m., respectively. Parathion residues at harvest were generally very low (0–0·13 p.p.m.) on all the crops tested regardless of treatment. When lucerne was dusted with 0·5 per cent. parathion and harvested on the same day, immediate analysis showed 20·4 p.p.m. parathion, but a sample that was dried in the greenhouse for four days by the usual procedure showed only 7·72 p.p.m. Exposures of the dusted plants to atmospheric conditions evidently causes decomposition, volatilisation or both. The low amounts found on all the harvested crops indicate that the same

process takes place in the field. For accurate estimation of residues, analysis should be made soon after harvest. Negligible quantities of parathion were recovered from maize kernels and shelled peas, indicating no translocation. Potato tubers from soil treated with 10 and 20 lb. parathion per acre contained small quantities of parathion when analysed soon after they were dug.

Bottger (G. T.) & Gertler (S. I.). **Comparative Toxicity to certain Insects of DDT, its Bromine and Fluorine Analogs, and Gamma Benzene Hexachloride.**—*J. econ. Ent.* **42** no. 4 pp. 611–614, 1 graph, 11 refs. Menasha, Wis., 1949.

The following is almost entirely the authors' summary. The insecticidal effectiveness of dusts containing DDT, bromo-DDT, fluoro-DDT and γ BHC (benzene hexachloride) in pyrophyllite was tested in the laboratory against *Cirphis unipuncta*, Haw., *Phlyctaenia rubigalis*, Gn., *Oncopeltus fasciatus*, Dall., *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) and *Gastroidea cyanea*, Melsh., by dusting the bodies of the sucking insects or the foliage supplied to chewing insects. The results showed that γ BHC was considerably more toxic than DDT or its analogues to all the insects but *P. rubigalis*, to which DDT was the most toxic. The fluorine analogue was about as toxic as DDT to *C. unipuncta* and *G. cyanea*, but only about a quarter as toxic to the other three insects. The bromine analogue showed much less toxicity than any of the other three materials.

Stitt (L. L.) & Evanson (J.). **Phytotoxicity and Off-Quality of Vegetables grown in Soil treated with Insecticides.**—*J. econ. Ent.* **42** no. 4 pp. 614–617, 7 refs. Menasha, Wis., 1949.

An account is given of experiments carried out at Puyallup, Washington, in 1948 to evaluate the phytotoxicity of parathion, BHC (benzene hexachloride) and chlordan and their effect on the quality or flavour of vegetable crops. Two forms of BHC were used, containing 37 and 99 per cent. γ isomer, respectively. Dusts containing 1 per cent. parathion or enough of either form of BHC to give 1 per cent. γ isomer were sifted on the surface of the soil at rates of both 0·5 and 2 lb. parathion or γ BHC per acre, and 5 per cent. chlordan at 5 and 34·8 lb. chlordan per acre, and the seeds were sown not more than one day later. Plant counts of seedlings 14 days after sowing showed that all the insecticides at the higher rate of application caused significant reductions in the numbers of cucumber plants. At harvest, there were no significant differences for cucumber, pole beans, carrots, onions and squash, but the higher rate of application of the 37 per cent. γ BHC reduced the numbers of plants of bush beans, beets and turnips and the lower one caused highly significant reductions of turnips. The 99 per cent. γ BHC was less phytotoxic, the higher rate causing significant reductions of bush beans and turnips only and the lower one causing no reductions. Parathion reduced plant stands of bush beans, beets, cauliflower and turnip at 2 lb. and bush beans at 0·5 lb. ; 34·8 lb. chlordan caused highly significant stand reductions for bush beans and turnips, but 5 lb. caused no significant decrease. BHC impaired the flavour of fresh peas and pole beans but had less effect on bush beans, carrots and cucumbers ; the dust containing 99 per cent. γ BHC caused less tainting than the other. Parathion and chlordan seemed to reduce the quality of fresh peas, pole beans and bush beans and possibly also of carrots and cucumbers.

Smith (C. F.), Jones (I. D.) & Rigney (J. A.). **Effect of Insecticides on the Flavor of Peaches—1948.**—*J. econ. Ent.* **42** no. 4 pp. 618–623, 5 refs. Menasha, Wis., 1949.

The authors describe experiments carried out in North Carolina in 1948 to determine the effect of various organic insecticides, especially BHC (benzene hexachloride), on the flavour of peaches. All were applied as wettable-powder sprays, 50 per cent. chlordan at 2 lb., 25 per cent. toxaphene at 4 lb., 25 per cent. parathion at 1 lb. and the BHC powder (10 per cent. γ isomer) at 2 lb. per 100 U.S. gals. The sprays were applied on some or all of six dates ending on 13th July, and tests for insecticidal residues were made on peaches harvested on 15th and 16th July from all plots except those treated with chlordan and for flavour on peaches harvested on 22nd and 27th July. Tasting of fresh fruit showed that applications of BHC late in the growing season definitely impair the flavour and that two or four early applications do so to some extent. Parathion and toxaphene had no adverse effects on fruit flavour, but the results with chlordan were conflicting. The flavour of canned fruit was similarly affected by BHC except when it was used only in the petal-fall and shuck-off sprays. The tainting became more noticeable as the number of sprays was increased or as they were applied nearer harvest. The other materials had no effect on the canned fruit.

Fruits sprayed 6, 5 or 4 times with BHC showed residues of 2·89, 0·76 and 0·29 parts per million on the surface and 0·66, 0·19 and 0·04 p.p.m. in the pulp, and those that received two early or one late application showed 0·03 and 1·87 p.p.m. on the surface and 0·01 and 0·57 p.p.m. in the pulp ; two late applications resulted in 2·95 p.p.m. on the surface. There appeared to be a correlation between the amount of residue in or on the peach fruit and the intensity of the off-flavour.

Analysis of fruit treated with toxaphene showed averages of 4·1 and 3·1 p.p.m. after six and five applications, respectively, but parathion was found in measurable amounts only on fruit that was sprayed on 13th July, picked on 16th July and analysed by 27th July.

Asquith (D.). **Oils in Dormant Sprays to control European Fruit Lecanium and Terrapin Scale on Peach.**—*J. econ. Ent.* **42** no. 4 pp. 624–626, 4 refs. Menasha, Wis., 1949.

The results are given of experiments carried out in Pennsylvania in 1948–49 to compare dormant oil products of low and high paraffinic type for the control of *Eulecanium* (*Lecanium*) *corni*, Bch., and *E.* (*L.*) *nigrofasciatum*, Perg., on peach and to observe their influence on the set of peach fruits when applied at different times during the dormant and delayed dormant periods. Oils of low paraffinic type are extensively used there against *E. nigrofasciatum*, but highly paraffinic oils have been found more effective against *E. corni* [*R.A.E.*, A **37** 379], which became an important pest of peach in the south-central part of the State in 1948.

Oil sprays of low or high paraffinicity applied in November, alone or with lime-sulphur or (in the case of the high one) aliphatic thiocyanates, gave 86–100 per cent. mortality of *E. corni* but poor control of *E. nigrofasciatum* and resulted in 82–88 per cent. fruit set. Similar oils applied in February or March gave equally good control of *E. corni* but poor control of *E. nigrofasciatum*, except for one of low and one of high paraffinic type applied at 4 and 2 gals. per 100 gals. on 14th March, which gave 84 and 71 per cent. mortality, respectively ; they had little effect on the set of fruits. The triethanolamine salt of dinitro-o-sec.-butylphenol, the sodium salt of dinitro-o-cresol or parathion were applied in some of the sprays ; they appeared of doubtful value against

the Coccids and reduced fruit set somewhat. The sprays in these experiments were of the mist type. In another test, two high paraffinic oils at 3 : 100 and one low paraffinic oil at 4 : 100 applied on 30th March, when 18 per cent. of the blossoms were open, resulted in 85, 90 and 73 per cent. mortality of *E. nigrofasciatum* and 83, 84 and 27 per cent. fruit set when applied as mists and 100, 97 and 99 per cent. mortality and 85, 91 and 50 per cent. fruit set when applied as driving sprays, from which it is concluded that low-paraffinic type oils are not so safe as high paraffinic-type oils for application to peach in the pink-bud stage and that oil applied as a driving spray kills a higher proportion of *E. nigrofasciatum* than the same oil applied as a mist.

ADAMS (J. A.). *Cyclocephala borealis* **as a Turf Pest associated with the Japanese Beetle in New York.**—*J. econ. Ent.* **42** no. 4 pp. 626–628, 7 refs. Menasha, Wis., 1949.

The following is based on the author's summary. Grub damage to turf in the vicinity of New York City in 1947 and 1948 was found to be due to mixed populations of Lamellicorn larvae [*cf. R.A.E.*, A **38** 214]. In some cases, most of the larvae were of the genus *Cyclocephala*, presumably *C. borealis*, Arr. These seemed to occur only in the area within 35 miles of New York City, and the turf damage to which they contributed was popularly attributed to a resurgence of *Popillia japonica*, Newm., so that confidence in the programme for the biological control of that species was reduced [*cf. loc. cit.*].

Preliminary experiments on control were made on Long Island on turf infested by larvae of *P. japonica* and *Aserica* (*Autoserica*) *castanea*, Arr., as well as *Cyclocephala* ; 6 and 12 lb. 10 per cent. DDT dust, 5 and 10 lb. 5 per cent. chlordan dust and mixtures of 3 and 6 lb. DDT dust with 2·5 and 5 lb. chlordan dust, respectively, were applied to plots 1,000 sq. ft. in area on 6th May. Immediate control was not complete, but all treatments almost eliminated the new generation of all three species in the autumn. Although milky disease (*Bacillus popilliae*) was found in 12·5 per cent. of the *Popillia* larvae dug near the plots in the autumn, it was not found in *Cyclocephala* larvae in the same soil. Larvae of *Tiphia relativa*, Vier., were found attached to about 10 per cent. of the *Cyclocephala* larvae in mid-October.

TASCHENBERG (E. F.). **Laboratory Evaluation of Larvicides for Red-banded Leaf Roller and Notes on Injury to Grapes.**—*J. econ. Ent.* **42** no. 4 pp. 629–632, 3 figs., 3 refs. Menasha, Wis., 1949.

Eulia (*Argyrotaenia*) *velutinana*, Wlk., was more common than usual on vines in the north-eastern United States in 1948, 4 per cent. of the grape clusters being injured by the second generation in one vineyard in New York, and various insecticides were therefore tested in the laboratory against the larvae. Techniques developed for obtaining large numbers of egg masses and for testing the insecticides, all of which were used in wettable-powder sprays, on leaf disks are described. Control was calculated by Abbott's formula [*R.A.E.*, A **13** 331]. Sprays of 4 oz. 50 per cent. DDD (dichlordiphenyldichlorethane) per 100 U.S. gals. gave 71·9–97·8 per cent. control of newly hatched larvae in various tests, and 8 oz. gave 100 per cent. Control was not much affected when DDD was applied in Bordeaux mixture (2 : 2 : 100). DDT was less effective than DDD, 8 oz. 50 per cent. powder per 100 U.S. gals. giving not more than about 90 per cent. control, and was slow in action. Lead arsenate appeared to be about as effective as DDT, but killed much more slowly. DDD was much superior to DDT, methoxy-DDT (methoxychlor) and methyl-DDT (ditolyltrichlorethane) against larvae 2–3 days old ; the 50 per cent. powder gave 80–95 per cent. control of larvae 2–3 and 16 days old at 4–8 oz. per 100

U.S. gals. and 96 per cent. control of larvae 23 days old at 1 lb. Parathion gave complete control of newly hatched larvae at 2–8 oz. 25 per cent. powder per 100 U.S. gals. and of 23-day-old larvae at 4 oz., but was less effective at lower concentrations. Since the larvae were in closed dishes, some of the mortality caused by parathion may have been due to fumigant effect.

Cox (J. A.). **Control of Plum Curculio on Prunes.**—*J. econ. Ent.* **42** no. 4 pp. 632–635, 7 refs. Menasha, Wis., 1949.

The following is based partly on the author's introduction and summary. *Conotrachelus nenuphar*, Hbst., is one of the most troublesome pests of prunes in Erie County, Pennsylvania, where it not uncommonly injures 25 per cent. of the fruit even in orchards that are well cared for, and since sprays of lead arsenate have not proved entirely satisfactory against it, its biology and control were studied in 1947 and 1948.

Life-history studies and field observations indicated that there was only one generation a year in Erie County. The adults appear in prune orchards at about petal-fall, and reach maximum numbers during the next fortnight if the weather is warm. In control experiments, three applications, at shuck split (25th May in 1947 and 28th May in 1948), at shuck fall (2nd and 9th June) and on 10th and 16th June, respectively, of BHC (benzene hexachloride) at the rate of 0·18 lb. γ isomer, with 1 lb. fixed copper, 2 lb. hydrated lime and 2 U.S. quarts oil per 100 U.S. gals. gave satisfactory control in both years (2 larvae or less per 100 fruits), as also did three of 0·25 lb. parathion with 6 lb. wettable sulphur per 100 U.S. gals. or two, on the first two dates, of 0·5 lb. parathion with 6 lb. wettable sulphur per 100 U.S. gals. (0·7 and 0 larvae, respectively) in 1948. Lead arsenate proved relatively ineffective. No spray injury to the fruit or foliage was observed where BHC or parathion had been applied, and no off-flavour could be detected in fruit from trees that had been sprayed with BHC. Trees that had been sprayed with BHC or parathion were not attacked by *Hyalopterus arundinis*, F., whereas those sprayed with lead arsenate were heavily infested. Two applications of 1 lb. chlordan per 100 U.S. gals. in 1947, though fairly effective against *C. nenuphar*, severely injured the foliage and retarded tree growth and fruit development.

In order to test the effects of BHC and parathion on the eggs [or larvae (*cf. R.A.E.*, A **38** 155, 207)], some neglected prune trees were sprayed with 0·5 lb. parathion, with wettable sulphur, or 0·24 lb. γ BHC, with the fixed copper fungicide, lime and oil, per 100 U.S. gals. on 15th June 1948, when many of the fruits bore oviposition punctures. Over 600 fruits from each treatment were picked and hung in mesh bags over water. No larvae dropped from the fruits sprayed with BHC, and 218 from those sprayed with parathion.

O'Neill (W. J.). **Pear Psylla Control with Parathion.**—*J. econ. Ent.* **42** no. 4 pp. 636–639, 3 refs. Menasha, Wis., 1949.

Experiments were carried out in north-central Washington in 1948 in which parathion in sprays directed also against other pests gave good control of *Psylla pyricola*, Först., on pear in an orchard that had been heavily infested in 1947. There were four plots, and all spray quantities are given per 100 U.S. gals. The first plot received 1 lb. 25 per cent. parathion on 7th April and the same with 2 lb. 50 per cent. DDT on 12th June and 14th July. The second and third received the last two sprays only, and the fourth was given sprays of 5 U.S. quarts dormant oil with 3 U.S. gals. lime-sulphur on 10th April, 7 lb. 50 per cent. DDT with 4 oz. dinitro compound on 12th June, 12 fl. oz. nicotine sulphate with 2 U.S. gals. petroleum oil on 13th July, and 1 lb. 50 per cent. DDT with 4 oz. 15 per cent. parathion on 15th August. The numbers of

Psyllids caught on ten adhesive trap boards between 8th April and 8th June were 409 on the first plot and 3,040 on the second, and those caught between 21st June and 1st October were 980 on the first plot, 551 on the second, 426 on the third and 1,266 on the fourth.

Psyllids in a cloth cage that was hung in the first plot and thoroughly wetted with the drift from the parathion spray on 7th April suffered complete mortality in 24 hours, as compared with none in an unsprayed plot. Newly caught Psyllids were then liberated in the sprayed cage, in an unsprayed cage in the sprayed plot and in an unsprayed cage in the unsprayed plot, with resultant mortalities in 24 hours of 100, 10–15 and practically 0 per cent., respectively. Daily examination of the cages, with replacement of the Psyllids whenever complete mortality was reached in any of them, showed 50 per cent. mortality in sprayed and unsprayed cages in the sprayed plot and less than 5 per cent. in the unsprayed plot on 10th April, complete mortality in the sprayed cage but not in the others on 12th April, low mortality in the sprayed cage and complete mortality in the unsprayed cage in the sprayed plot but not in the unsprayed plot on 13th April and complete mortality in the other unsprayed cage by 15th April. Chemical analyses of parathion spray deposits have indicated a rapid loss of parathion by volatilisation during the first few days after application, followed by a slower rate of loss, and the results obtained in these experiments are in general agreement with this and suggest that parathion acts both as a contact poison and as a fumigant in controlling adult Psyllids.

Hatching began about 20th April, while oviposition was still heavy, and on 23rd April no eggs, nymphs or adults were found on 50 buds from the plot sprayed on 7th April, whereas 935 eggs, 10 nymphs and 5 adults were found on 50 buds from unsprayed plots. The absence of eggs on the new growth in the sprayed plot was attributed to adult mortality caused by the spray, and the absence of nymphs was found to be due to the destruction of eggs by the parathion. This was confirmed by counts of eggs and nymphs on leaves in the various plots. Analysis on 2nd October of fruit picked on 21st September showed residues of 0·04–0·1 part parathion per million. The percentages of fruits marked by the Psyllid from the four plots were 0·96, 0·07, 0·2 and 83, respectively. The tests indicated that inter-orchard and inter-plot migration of the Psyllid is greater than generally recognised, and it is suggested that for maximum control all pear trees within an infested area should be sprayed at about the same date, to minimise adult migration.

Mason (A. C.) & Chisholm (R. D.). **An Ethylene Dibromide-Chlordan Mixture to control Soil-inhabiting Stages of the Japanese Beetle.**—*J. econ. Ent.* **42** no. 4 pp. 639–641, 4 refs. Menasha, Wis., 1949.

Since ethylene dibromide and chlordan have both been shown to be effective against *Popillia japonica*, Newm., in soil, though some plants are injured by the former [*cf. R.A.E.*, A **35** 129 ; **37** 305], a mixture of the two at reduced concentrations was tested. About 16 oz. ethylene dibromide, 8 oz. each of technical chlordan, ethylene glycol monoethyl ether and emulsifier (a polyoxyalkylene derivative of sorbitan monolaurate) and enough 99 per cent. isopropyl alcohol to make 1 U.S. gal. were mixed in that order, and the product was diluted for use by pouring into water ; the emulsion so formed was easily dispersed with moderate stirring. In the diluted preparation, the ethylene dibromide was in aqueous solution and the chlordan was dispersed as an emulsion of very small particle size.

Plant balls 8–10 ins. in diameter and artificial soil balls (prepared by compacting soil into wire-netting forms to simulate plant balls) 4 or 8 ins. in diameter were immersed in a dip containing 3 ml. concentrate in 1 U.S. gal.

water until they were thoroughly soaked. The soil temperatures were 65–80°F. When the plant or soil balls contained eggs, less than half hatched if left in the treated soil for one day and practically none if left in it for a week, and no living eggs or larvae were found in treated balls left undisturbed for three weeks. When third-instar larvae were left in treated plant or soil balls at 60–80°F. for 1–14 days, all died within seven days after removal from them, and when they were inserted into soil balls at intervals up to 21 days after treatment and left for 14 days, they all died. Recently hatched larvae died within five days after they were put in the soil from plant balls that had been dipped four weeks before. When larvae were put in the balls and allowed to pupate before the balls were dipped, a few beetles emerged, all during the first two days after treatment, but died within 48 hours, and no living pupae or adults were found at the end of 15 days. Adults that were buried in wire cages in soil balls before they were dipped and removed to clean cages 24 hours after dipping all died within three days.

In tests on turf, batches of about 3,000 beetles were caged over square-yard plots for oviposition and removed after five days, and the turf was then sprinkled with 20 or 30 ml. concentrate in 1 or 2 U.S. gals. water per sq. yard or left untreated. Three weeks later, there were 1,680 first-instar larvae in the untreated plots, but only one was found in the treated ones. Similar plots with natural populations of 150–500 third-instar larvae per sq. yard were treated with 5, 10 or 15 ml. concentrate, each in 0·25, 1 or 2 U.S. gals. water, when the 3-inch soil temperatures were 56 and 65°F., and the larvae were transferred to clean soil 5–7 days after treatment and left for two weeks. No larvae survived from plots treated with 5 or 10 ml. concentrate in 2 U.S. gals. water, but the same amounts or even 15 ml. in smaller quantities of water were less effective, though there was at least 80 per cent. mortality for all plots. In turf with an estimated population of 200 newly formed pupae per sq. yard, no beetles or pupae survived treatment with 30 ml. concentrate in 1 or 2 U.S. gals. water per sq. yard, but 1–16 were recovered after two weeks from soil treated with 20 ml. in 1 or 2 U.S. gals. In similar tests on pupae about to transform to adults, 2–8 beetles emerged from plots that received 30 ml. in 1 or 2 U.S. gals. per sq. yard and 1–5 from soil treated with 20 ml. in 1 or 2 U.S. gals., and a few living adults were found in the soil of these plots ; the 1- and 2-gal. applications appeared to be equally effective. In all plots, many of the beetles that emerged appeared to be weakened and died within a day or two.

Plant-balls of many varieties of plants were dipped by nurserymen in mixtures of ethylene dibromide and chlordan with no injury to the plants. No injury to turf was observed when the applications did not exceed 20 ml. concentrate per U.S. gal. per sq. yard, but there was temporary yellowing of the grass in some plots that received 30 ml. in 1 U.S. gal.

Since dipping in 3 ml. concentrate per U.S. gal. at temperatures above 60°F. freed plant balls from all stages of *P. japonica*, the use of this procedure under specified conditions was approved by the U.S. Bureau of Entomology and Plant Quarantine in 1948, for the treatment of balled or potted plants, which can now be shipped to points outside the restricted area in the United States at any time of year ; previous treatments had to be applied when no other stages but larvae were in the soil.

Glass (E. H.) & Crosier (W. F.). **The Viability of Seeds fumigated with an Acrylonitrile-Carbon Tetrachloride Mixture.**—*J. econ. Ent.* **42** no. 4 pp. 646–649, 2 refs. Menasha, Wis., 1949.

A mixture of equal volumes of acrylonitrile and carbon tetrachloride [*cf. R.A.E.*, A **31** 404] has recently become available in the United States as

a commercial fumigant (Carbacryl). It has been used primarily for the control of insects in such stored products as flour, wheat and tobacco, and investigations were undertaken to determine whether it would reduce the viability of seeds intended for planting. The mixture is a clear colourless liquid with a boiling point of 69°C. ; it evaporates readily when not confined, and its vapour is 3·2 times as heavy as air and is toxic to insects, but not to warm-blooded animals except at relatively high concentrations or after prolonged exposure. The fumigant is normally effective against pests of stored products at rates of 2–3 lb. per 1,000 cu. ft. for exposures of 24–48 hours, but tests were made with 1, 2, 3 and 5 lb. per 1,000 cu. ft. for 24 and 48 hours and, in the case of beans, lima beans, carrot and radish, with 25 lb. for 24 hours to determine the effect of excessive as well as normal rates. The fumigant was poured on paper towelling just above the seed and the fumigation chamber was sealed immediately. The treated seed was kept for one week or seven or ten months before being sown. Seeds of beans, lima beans, beet, cabbage, carrot, lettuce, onion, pea, radish, tomato, various cucurbits, maize, oats and wheat were used, including several varieties of some of them, and there was no evidence that fumigation had any immediate or delayed deleterious effect. It did not affect the incidence or growth of moulds, and three fungicides commonly dusted on seeds protected fumigated seeds as efficiently as unfumigated ones.

Richardson (H. H.). **Methyl Bromide Fumigation of imported Orchid Plants.**—*J. econ. Ent.* **42** no. 4 pp. 650–652, 3 refs. Menasha, Wis., 1949.

The following is partly based on the author's summary. Observations were made on 72 lots of orchid plants imported from various countries to determine whether fumigation with methyl bromide, which is required as a condition of entry into the United States, caused a reduction in quality. Two lots of plants were segregated from each shipment, and individual records of leaf and pseudobulb loss and new growth were made, one sample serving as the control and the other representing the fumigated shipment. From a total of 50,249 plants, 3,087 were observed for periods of up to 20 months after importation. These represented shipments of good and poor quality, transported by air or water, and in dormant, semi-dormant and full-growth condition. Dormant plants of eight species of *Cattleya* were fumigated in a 15-inch vacuum with a dosage of 3 lb. methyl bromide per 1,000 cu. ft. for two hours at 70°F. or for 1½ hours at 80°, and dormant, semi-dormant or growing plants of 18 species in this and other genera at atmospheric pressure for two hours with 2 lb. methyl bromide per 1,000 cu. ft. at 70°, with 1¾ lb. at 75°, or with 1½ lb. at 80°. There was no lowering of quality except when two inferior lots of *Cattleya gigas* were fumigated in the vacuum. Vacuum fumigation was rendered necessary by the presence of *Eurytoma orchidearum*, Westw., and leaf-mining insects. Complete control of all was obtained.

Chamberlin (T. R.) & Medler (J. T.). **Tests of Insecticides against the Meadow Spittlebug on Seed Alfalfa.**—*J. econ. Ent.* **42** no. 4 pp. 653–656, 1 ref. Menasha, Wis., 1949.

The following is based on the authors' summary. Three further experiments [*cf. R.A.E.*, A **37** 435] were carried out in Wisconsin in 1948 in which various insecticides were sprayed on first-growth lucerne for the control of *Philaenus leucophthalmus*, L. Hand and low-pressure power sprayers were used, and DDT, chlordan and toxaphene were tested in water suspensions and emulsion sprays and BHC (benzene hexachloride) and parathion in suspensions. Toxaphene, either in an emulsion spray or a suspension, was very effective and the best of the materials tested ; although up to 6 lb. of this material was applied per

acre, 1·5 lb. appeared to be equally satisfactory. Chlordan in emulsion sprays and suspensions at 1–2 lb. per acre was not so uniformly effective as the chlordan suspensions and dusts used in 1947 [*cf. loc. cit.*]. Suspensions of BHC wettable powder (5 per cent. γ isomer) at 0·133 lb. γ isomer per acre and DDT in an emulsion spray at 1 lb. per acre showed some promise, but parathion as a water suspension at 0·25 lb. per acre was ineffective.

Adelphocoris lineolatus, Goeze, was abundant in some of the fields sprayed with toxaphene or chlordan and was very effectively controlled by them ; it is considered that the heavier and earlier bloom and the better setting of seed in the treated plots were due to the control of both insects. These experiments showed clearly that low-pressure sprays in small quantities can be used effectively on seed lucerne.

Stafford (E. M.). **Control of Olive Scale in California with Parathion.**— *J. econ. Ent.* **42** no. 4 pp. 656–660, 4 refs. Menasha, Wis., 1949.

Parlatoria oleae, Colv., was first reported in California near Fresno in 1934 and has since spread through much of the central valley and into southern California. Lack of effective natural enemies, difficulty of control and a large variety of food-plants have facilitated this spread. Control has been by tent fumigation with hydrocyanic acid gas for olives and by spraying with oil emulsion for olives and deciduous fruit trees, but neither is satisfactory in all circumstances.

In preliminary tests in the spring and summer of 1947, parathion showed considerable promise, and further tests were therefore begun in November. On olive, sprays of 3–7 lb. 15 per cent. parathion wettable powder per 100 U.S. gals., alone or with other organic insecticides, or adjuvants, applied on 11th November gave poor kills of adult females, but through the remainder of the winter and in the spring of 1948, swelling of the adult females and consequent lifting of the scale coverings often resulted. Some scales died, but others apparently returned to normal size, since subsequently, great numbers of scales of the usual size were observed to have coverings that were connected to the lower shell and plant surface only along a very small fraction of the perimeter. By spring, many of these had fallen, and in April many living individuals were producing considerable amounts of cottony wax, which is rarely seen on untreated scales. Only 8·9 and 5·6 per cent. of treated females were ovipositing on 27th April and 12th May, respectively, as compared with 30 and over 98 per cent. on unsprayed trees, and 0–6 per cent. of the young fruits were infested on treated trees on 24th June, whereas 24·2 per cent. were infested on untreated ones, but by harvest in October, the infestation was so great that none of the treatments was considered satisfactory, though all reduced the numbers of infested fruits.

On peach, sprays of 3–4 lb. 15 per cent. parathion per 100 U.S. gals. and combinations of these sprays with 1 U.S. quart di-2-ethylhexylphthalate, alone or with 2 U.S. gals. kerosene, or with 1 U.S. quart dormant oil emulsion, applied in January 1948, killed less than 50 per cent. of the overwintering female scales. The Coccids reacted to parathion in the same manner as on olive, and the resulting delay in oviposition of sprayed scales was reflected in the smaller numbers of the first generation per leaf in early June.

On olive, 1–3 applications of 4 per cent. parathion dust at 50–100 lb. per acre on five different dates between 30th April and 4th June gave unsatisfactory results, the lowest percentage of fruits infested at harvest being 76·5, on trees treated three times. Dusts applied after hatching had begun gave better control as measured by the numbers of Coccids per 100 olives. On peach, the same dust applied once or twice between 30th April and 26th May gave better control, possibly because hatching began earlier and finished in much less

time than on olive. Dusts applied in late May were more effective than those applied in late April or early May.

Sprays of 0·9 lb. actual parathion in wettable powder per 100 U.S. gals., applied to olive on 28th April or 11th May, before flowering, resulted in no infested olives on 24th June and 15·5 and 11 per cent., respectively, on 8th October, and 1·2 lb. on the same dates resulted in no infested olives on 24th June and 19 and 9 per cent. in October. The addition of 2 U.S. quarts vinyl resin latex or 1 U.S. quart di-2-ethylhexylphthalate to 0·45 lb. parathion per 100 U.S. gals. possibly increased its effectiveness, but as these adjuvants are dangerous to the operators their value is doubtful. Sprays of 0·6 lb. parathion and of parathion with other adjuvants were less effective. A July spray of 2 gals. medium grade summer oil per 100 gals. resulted in 53·1 per cent. infested fruit in October. Most of the sprays gave better results when applied on 11th May, and in further tests, applications of 0·6 lb. parathion were much more effective on 20th May or 3rd or 24th June than on either of the earlier dates, indicating that parathion is effective against eggs and young scales. A spray of 4 lb. 15 per cent. parathion per 100 U.S. gals. applied to peach on 28th April, when the fruits were about 0·75 in. in diameter, gave good control in spite of heavy rain during the following night and a large overwintering scale population.

Two applications of 2 per cent. parathion dust at 150–200 lb. per acre on 13th July and 2nd August resulted in considerable kill of young and adult female scales on olive, delay in oviposition and sterility of females owing to lack of fertilisation [*cf. R.A.E.*, A **36** 342], caused by the greater susceptibility of the males to parathion, but did not give satisfactory control, though they gave excellent results against *Saissetia oleae*, Bern.

Bronson (T. E.), Dudley jr. (J. E.) & Chapman (R. K.). **Liquefied-Gas Aerosols for Pea Aphid Control.**—*J. econ. Ent.* **42** no. 4 pp. 661–663, 4 refs. Menasha, Wis., 1949.

Liquefied-gas aerosols were compared with impregnated dusts containing 1·25, 2·5 and 3 per cent. DDT, with a methylated naphthalene, carbon tetrachloride and trichlorethylene, respectively, as the solvents, for the control of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) on peas in Wisconsin in 1946–48. The aerosols were dispensed by means of a specially constructed boom under a hood, which had nozzles pointing forwards or backwards at an angle of 45° and downwards at the same angle and arranged so that all the plants should be hit. The aerosol machine travelled at the rate of 4·5 miles per hour, and DDT aerosol mixtures were applied at 11 lb. per acre and the others at 14 lb. per acre. The dusts were applied at 35 lb. per acre by means of a power duster equipped with an enclosed 24-nozzle boom and a 45-ft. apron, travelling at 2·5 miles per hour. The treatments in each year were applied in June when the peas were 8 ins. high.

In 1946, an aerosol mixture containing 5 per cent. each of DDT, methylated naphthalene and cyclohexanone, 35 per cent. acetone and 50 per cent. methyl chloride and the 2·5 per cent. dust were applied to peas with an average infestation of 60 Aphids per sweep. The wind velocity averaged 7–12 miles per hour, and the temperature was 78°F. The average numbers of Aphids per sweep two and seven days after application were 6 and 9 in the dusted plots and 28 and 38 in those receiving the aerosol.

In 1947, four aerosol mixtures and the 3 per cent. dust were applied to peas with an average infestation of 100 Aphids per sweep, when the wind velocity was 5–9 m.p.h. and the temperature 80–82°F. Two days after treatment, the average numbers of Aphids per sweep were 7 for the dust, 6 and 3 for aerosols of 5 or 10 per cent. of a material containing 95 per cent. TEPP (tetraethyl

pyrophosphate) with 95 or 90 per cent. methyl chloride, 16 for an aerosol of 5 per cent. DDT, 10 per cent. methylated naphthalene, 35 per cent. acetone and 50 per cent. methyl chloride and 32 for one of 10 per cent. HETP (hexaethyl-tetraphosphate material containing about 20 per cent. TEPP) and 90 per cent. methyl chloride, as compared with 249 for no treatment. The last aerosol was significantly inferior to the first two and the dust. Yields were measured on the dusted plot and those receiving aerosols of DDT and 10 per cent. TEPP ; they were 16–19 per cent. higher than that from no treatment.

In 1948, three aerosols and the 1·25 per cent. dust were applied to peas with an average infestation of 234 Aphids per sweep, when the wind velocity was 7–10 m.p.h. and the temperature 68°F. Two days later, the average numbers per sweep were 10 for the dust, 4 for an aerosol of 5 per cent. of a material containing 40 per cent. TEPP and 95 per cent. methyl chloride, 2 for one of 2 per cent. parathion in methyl chloride and 14 for one of 5 per cent. DDT, 10 per cent. of a methyl naphthalene, 35 per cent. acetone and 50 per cent. methyl chloride, as compared with 298 for no treatment ; the difference required for significance was 4. Yields were measured on the plots treated with the dust and the parathion aerosol and were significantly higher (51 and 48 per cent. increase, respectively) than those on untreated plots.

Although aerosols gave good control of the Aphid, dusts appear to be more practical and economical at present. Methyl chloride is poisonous, but should involve no great hazard in application out of doors with reasonable care. TEPP and parathion are extremely poisonous, and workers applying aerosols containing either should wear suitable gas masks.

Dogger (J. R.) & Lilly (J. H.). **Seed Treatment as a Means of Reducing Wireworm Damage to Corn.**—*J. econ. Ent.* **42** no. 4 pp. 663–665. Menasha, Wis., 1949.

Severe wireworm damage to maize planted on sod land or reclaimed marsh-land is common in Wisconsin, and the direct feeding on seed and seedlings that occurs early in the season reduces the stands and stunts the plants that survive. In the spring of 1948, a planting of maize was completely destroyed by wire-worms in soil that had recently been cleared of marsh grasses and was under cultivation for the first time. It was a moist peat soil with only fair drainage and subject to run-off from an adjacent hill. The predominant species was *Melanotus communis*, Gylh., and large numbers of *Dalopius pallidus*, Brown, and smaller numbers of *Agriotes mancus*, Say, were present, with a few larvae of *Aeolus mellilus*, Say ; there were approximately one million wireworms per acre. On 23rd June, after the peak of wireworm activity was past, the field was resown with maize seed that had been treated with a fungicide and was then moistened sparingly with water and mixed thoroughly with 4 or 8 oz. of powders containing 50 per cent. parathion, chlordan, or γ BHC (98 per cent. γ benzene hexachloride) per bushel on 18th June. In laboratory tests, all samples gave 100 per cent. germination. Seeds treated with parathion germinated before untreated seeds or those treated with the other materials, and in the field, growth as well as germination appeared to be accelerated by parathion, which caused no injury to seeds or seedlings. Treatment with 4 oz. γ BHC powder caused root deformity in the laboratory and treatment with 8 oz. caused more pronounced deformity and some necrotic tissue at the root tips, but no root injury was observed in the field. Chlordan had no effect on seeds or seedlings in the laboratory, and field observations were prevented by the heavy wireworm damage. Both laboratory and field tests showed that parathion, applied to the seed, was highly toxic to wireworms. BHC was toxic in the laboratory and gave some protection in the field. Injury occurred where the infestation was heaviest, but no injured plants were found in the more lightly infested parts

of the plots, and it is possible that BHC has some repellent action. This was supported by the fact that relatively few dead larvae were found in the BHC plots, and these were in the more heavily infested parts. Chlordan proved ineffective in both laboratory and field.

Michelbacher (A. E.), Middlekauff (W. W.), Lamb (F. C.) & Akesson (N. B.). **Further Investigation of Control of Tomato Insects in northern California.**—*J. econ. Ent.* **42** no. 4 pp. 666–674, 6 refs. Menasha, Wis., 1949.

The following is based on the authors' summary. The effectiveness and suitability of DDT and DDD (dichlordiphenyldichlorethane) in dusts and sprays for the control of caterpillars attacking tomatos were extensively investigated in northern California in 1946–48 [*cf. R.A.E.*, A **37** 180]. With a single exception they proved to be more effective than calcium-arsenate dusts. Against *Protoparce sexta*, Joh., calcium arsenate is more effective than a 5 per cent. DDT dust, applied at the rate of 30 lb. per acre, though if an equivalent amount of DDT is applied as a wettable powder in a suspension spray or as an emulsion spray, satisfactory control is assured. Not more than three applications of DDT or DDD were necessary to ensure excellent control. For each application, 30 lb. 5 per cent. dust or 3 lb. 50 per cent. wettable powder should be applied per acre.

Other chlorinated hydrocarbons investigated were methoxy-DDT (methoxychlor) and toxaphene. The former, as a dust and as a water suspension, gave the poorest control of any of the chlorinated hydrocarbons tested, its range of effectiveness being rather similar to that of calcium arsenate. Toxaphene applied as a 10 per cent. dust at the rate of 30 lb. per acre gave rather satisfactory control, and excellent results were obtained where it was used in combination with DDT ; a dust containing 5 per cent. toxaphene and 3 per cent. DDT applied at 30 lb. per acre per application warrants additional study.

In order to ensure control of *Vasates* (*Phyllocoptes*) *destructor*, Keifer, the insecticides should be used with sulphur, though if injury by the mite is not apparent by early September, the sulphur can be safely omitted from the later treatments. In dusts, the sulphur content should not be less than 50 per cent.

The 1948 season marked the close of the second year in which DDT and DDD were used extensively for the control of insects attacking tomato. Whether or not the widespread use of these insecticides exerted an influence on normally unimportant pests of tomatos is not known, but there was a noticeable increase in the population of some of these. Most important was that of a leafminer, *Liriomyza* sp., which by the end of the season was so abundant in many fields as to cause considerable defoliation. Little damage resulted, although in at least two fields defoliation occurred so early in the season that there was serious loss of fruit due to sunburn. *Estigmene acraea*, Dru., was present in larger numbers than usual and caused slight damage, and a mite, probably *Tetranychus pacificus*, McG., was abundant in several fields.

Insignificant amounts of insecticide residue were present on washed tomatos and in the juice extracted from them. Considerably higher residues were present in the pomace or residue from juice extraction, particularly with the new organic insecticides. Arsenic was reduced to about the same level as the other insecticides after washing, but did not show so marked an increase in concentration in the pomace as did DDT, DDD and toxaphene. From the information obtained, it appears that there is no serious residue hazard involved in canning tomatos where DDD, DDT or the mixture of DDT and toxaphene are used, particularly if they are not applied at concentrations higher than those here recommended. In all cases, the samples from the commercial blocks contained 0·05 part per million or less of residue in the juice and 0·5–1·7 p.p.m. in the

pomace. Because of the relatively higher residue in the pomace, it should probably not be fed to livestock.

Greenwood (D. E.) & Hofmaster (R. N.). **Corn Earworm Control Studies in Virginia.**—*J. econ. Ent.* **42** no. 4 pp. 675–677. Menasha, Wis., 1949.

In the Norfolk area of Virginia, *Heliothis armigera*, Hb., infests sweet maize of all plantings, and all stages are present throughout most of the season. The results obtained from the application of numerous dusts in 1948 are given in tables and discussed. It is concluded from them that materials used successfully elsewhere are less effective in Virginia and do not produce consistent results throughout the season. They were applied to the plants at the levels of the silks at rates of 30–35 lb. per acre, usually three times at intervals of 2–3 days from the time when the plants had been in silk for about four days. DDT and parathion were more promising than methyl-DDT (ditolyltrichlorethane), benzene hexachloride, piperonyl cyclonene with pyrethrins or DDD (dichlordiphenyldichlorethane). A 3 per cent. regular DDT dust was not effective under conditions of heavy infestation, but 3 per cent. impregnated DDT was promising. The variation in degree of control obtained with these materials indicates the influence of such factors as varietal preference, inherent physical characteristics of varieties other than palatability, and the effect of food-plant condition on oviposition habits. The extremely high earworm populations in the Norfolk area tend to accentuate all these factors ; random counts have shown as many as 22 newly hatched larvae in the silk channel and as many as 53 eggs on the silk of a single ear.

Kulash (W. M.). **The Green Peach Aphid as a Pest of Tobacco.**—*J. econ. Ent.* **42** no. 4 pp. 677–680, 10 refs. Menasha, Wis., 1949.

As a result of a severe outbreak of Aphids identified as *Myzus persicae*, Sulz., on field tobacco in North Carolina in 1948, further investigations were carried out on their control [*cf. R.A.E.*, A **38** 60]. The plants were treated in the morning after the dew had dried ; dusts were applied to both sides of the leaves at about 30 lb. per acre, sprays at about 80 U.S. gals. per acre, and liquefied-gas aerosols directly to the top of each plant through a cone-shaped shield, 10 ins. in diameter at the top and 20 ins. at the bottom, which confined the aerosol near the plant. The numbers of Aphids per leaf one day after treatment were : 0 for an aerosol of 1 per cent. TEPP (tetraethyl pyrophosphate) and 1·5 per cent. other organic phosphates in methyl chloride, a dust containing 1 per cent. parathion, and a dust containing 0·66 per cent. TEPP ; 25 for a spray of 1 quart 20 per cent. TEPP per 100 gals. ; 50 for an aerosol of 1 per cent. rotenone, 0·2 per cent. pyrethrins, 3 per cent. piperonyl butoxide and 10 per cent. methylated naphthalene in 82 per cent. Freon 12 [dichlordifluoromethane], another of DDT, methylene chloride and methyl chloride (10 : 40 : 50), and a third of DDT, chlorinated camphene [toxaphene], methylene chloride and methyl chloride (5 : 5 : 40 : 50), and for γ BHC (purified, odourless γ benzene hexachloride) applied as a 1·5 per cent. dust or in a spray containing 6 oz. per 100 U.S. gals. ; 1,000 for a dust of 0·2 per cent. rotenone and 0·8 per cent. piperonyl cyclonene ; and 1,000 or more for no treatment. The TEPP aerosol killed the Aphids almost instantly, but the plants treated with TEPP in either form were reinfested much sooner than those treated with parathion or γ BHC. It is considered that improvements in methods of application must be made before aerosols can be economically used for Aphid control on tobacco. The foliage was scorched if the outlet nozzle was held too near the plant, and despite the cone-shaped shield, it was difficult to get good coverage of both sides of the leaves, principally because of slight gusts of wind.

Predators sometimes give a high degree of control of the Aphids. During 1948, Coccinellid larvae and adults, Syrphid and Chrysopid larvae, and nymphs and adults of *Jalysus spinosus*, Say, were the most important. They were abundant in several fields, but when Aphid infestation is heavy and there are no predators, insecticidal treatment is usually necessary. The effect of temperature and moisture on the abundance and distribution of the Aphids in the tobacco is not clearly understood. Infestation usually began in the parts of individual fields that were low and wet or were near woods. Aphids in shady places continued to live for days after Aphids in the sun had disappeared or died, although they were heavily preyed on by Coccinellids.

Frost (S. W.). **The Diamondback Moth in Pennsylvania.**—*J. econ. Ent.* **42** no. 4 pp. 681–682, 10 refs. Menasha, Wis., 1949.

Collections of adults of *Plutella maculipennis*, Curt., in light-traps operated in 20 localities in Pennsylvania in 1947 and 1948 showed that the moths were common in the central and eastern parts of the State, but rare in the west and north ; lack of cruciferous crops in certain areas doubtless accounted for the low catches there. The traps were equipped with a 25-watt bulb, a motor and a fan producing a down draught of about 400 ft. per minute, and a cyanide bottle. The use of 60- and 100-watt lamps did not seem to increase the catches. Traps were in operation from 23rd May to 12th September, but the moths were evidently in flight for a longer period than this. They were taken almost continuously, but fluctuations in their numbers indicated that six generations were produced in the year. Observations in 1948 indicated little or no relation between moth flight and weather, though temperature was more important than rainfall or wind velocity. Counts of caterpillars on cabbage at State College in September showed that the imported cabbage worm [*Pieris rapae*, L.] was much the most abundant species, and the cabbage looper [*Trichoplusia ni*, Hb.] was more numerous than *Plutella maculipennis*, but the catches in light-traps indicate that *P. maculipennis* may sometimes be numerous enough in Pennsylvania to warrant consideration.

Fife (L. C.), Walker (R. L.) & Bondy (F. F.). **Boll Weevil Control with several organic Insecticides during 1948.**—*J. econ. Ent.* **42** no. 4 pp. 682–684. Menasha, Wis., 1949.

In further work on the control of *Anthonomus grandis*, Boh., on cotton in South Carolina, carried out in 1948 [*cf. R.A.E.*, A **37** 459], various dusts were tested in four small-plot experiments, 8, 9, 7 and 16 applications being made, the first when infestation reached 28, 16, 34 and 10 per cent., respectively. All treatments increased the yields. In the first experiment, dusts containing enough technical BHC (benzene hexachloride) to give 2 or 3 per cent. γ isomer with 5 per cent. DDT gave better control and higher yields than 1 per cent. γ BHC with 5 or 10 per cent. DDT or than 5 per cent. DDT with 10 per cent. toxaphene or with 10 per cent. chlordan. In the second, 20 per cent. chlordan gave better control and a higher yield than 10 per cent. ; the addition of 5 per cent. DDT to 10 per cent. chlordan did not increase control but increased yield, probably owing to additional control of other injurious insects, and the addition of 1 per cent. parathion or rotenone to the mixture gave further yield increases. In the third, 20 per cent. toxaphene, alone or with 1 per cent. rotenone, 1 per cent. parathion, 40 per cent. sulphur or the last two together, and 10 per cent. toxaphene with 1 per cent. parathion all gave good control and high increases in yield, the latter being higher for the mixtures than for toxaphene alone and highest for 20 per cent. toxaphene with parathion or sulphur. The fourth test was in a cotton field planted on 10th June, about two months after the

average planting date. Infestation by *A. grandis* was very high, and there was a moderate infestation by the bollworm [*Heliothis armigera*, Hb.] and a light one by *Tetranychus atlanticus*, McG. Treatment was made at intervals of about three days from 28th June. The best weevil control was given by a dust containing 3 per cent. γ BHC, 5 per cent. DDT and 0·5 per cent. parathion, followed closely by 20 per cent. toxaphene with 0·5 per cent. parathion and by 2 per cent. γ BHC with 10 per cent. DDT, 40 per cent. sulphur and 2·3 per cent. of an unknown solvent. These treatments also gave much the highest yields. Mixtures containing 5 per cent. each of toxaphene, chlordan and DDT with 0·5 per cent. parathion, 20 per cent. chlordan with 0·5 per cent. parathion, or 10 per cent. chlordan with 5 per cent. DDT and 0·5 per cent. parathion gave less control and smaller yield increases. All treatments except that with 20 per cent. chlordan and 0·5 per cent. parathion gave good control of *H. armigera*. A moderate infestation of *T. atlanticus* developed after all treatments except that containing 40 per cent. sulphur, indicating that 0·5 per cent. parathion in every application of the various mixtures was not sufficient for good control of this mite.

Five large-scale experiments were also made. The results showed that three commercial mixtures, containing 5 per cent. DDT, enough technical BHC to give 3 per cent. γ isomer and 56 per cent. sulphur, 20 per cent. toxaphene with 40 per cent. sulphur, and 10 per cent. chlordan with 5 per cent. DDT and 40 per cent. sulphur applied at intervals of 3–7 days, reduced the average percentage of squares punctured by the weevil from 66 to 33–35 and doubled the average yields. Yields and control were best when applications were made at intervals of three or five days, and it appears that the interval between applications should not exceed five days for good control of the weevil during the middle or end of the season.

Walker (R. L.), Fife (L. C.) & Bondy (F. F.). **Comparative Effectiveness of Chlorinated Hydrocarbons against the Boll Weevil.**—*J. econ. Ent.* **42** no. 4 pp. 685–686. Menasha, Wis., 1949.

Two field-plot tests were carried out on late-planted cotton in South Carolina in 1948 to compare three commercial chlorinated-hydrocarbon dusts [see preceding abstract], 20 per cent. methoxy-DDT (methoxychlor) and 20 and 40 per cent. chlordan for their immediate effectiveness against *Anthonomus grandis*, Boh. The dusts were applied in the early morning, and the dead and paralysed weevils were collected on paper spread beneath the plants and counted at intervals for a week. The results showed that 50 per cent. or more of the knockdown and kill by each of the insecticides was effected within the first 24 hours. At the end of two and six hours, the mixture of BHC (benzene hexachloride) and DDT had caused a significantly greater knockdown and kill than any of the other insecticides, but after six and seven days toxaphene had killed or paralysed more weevils than the BHC mixture, the difference closely approaching significance ; there was no significant difference between these two dust mixtures at any of the other counts. Both knocked down significantly more weevils than any other material except at the two-hour count. Methoxy-DDT killed or paralysed significantly fewer weevils than any other material at each count. The results for the chlordan mixture are omitted from the table, but chlordan alone was intermediate in effectiveness between methoxy- DDT and the other dusts. No mortality occurred in the untreated plots. No rain fell during the tests and the mean temperatures were 77 and 79°F.

KULASH (W. M.) & HANSON (C. H.). **Insect Pests of Alfalfa in North Carolina.**—*J. econ. Ent.* **42** no. 4 p. 694, 2 refs. Menasha, Wis., 1949.

Lucerne is frequently unthrifty, short and yellow during late summer in North Carolina, and insect collections made in Wake County during the autumn of 1947 showed that such plants were usually infested by at least three of the commonest lucerne insects, whereas green thrifty fields were relatively free of them. The insects most commonly found were *Stictocephala festina*, Say, *Empoasca fabae*, Harr., *Lygus* spp., *Diabrotica undecimpunctata howardi*, Barber, and *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.). Grasshoppers and caterpillars (including the green clover worm [*Plathypena scabra*, F.] and the fall armyworm [*Laphygma frugiperda*, S. & A.]) were also found. Some fields were completely destroyed by *Laphygma* in 1947 and 1948.

S. festina was very abundant in many fields in 1947. It frequently girdled the stems with its feeding punctures, weakening and killing them. No strain of lucerne resistant to it was found among 76 growing in a nursery. In late-season stands, where the lucerne was not cut for hay or used for grazing, satisfactory control was obtained by dusting with 3 per cent. γ BHC (benzene hexachloride) or with a mixture containing 3 per cent. γ BHC and 5 per cent. DDT at the rate of 15–20 lb. per acre.

RINGS (R. W.). **Red-banded Leaf Roller Injury to Peaches and Plums.**—*J. econ. Ent.* **42** no. 4 pp. 701–702, 3 figs., 1 ref. Menasha, Wis., 1949.

The author describes the damage caused to plum and peach fruits by *Eulia* (*Argyrotaenia*) *velutinana*, Wlk., as observed in Ohio in 1948. In most cases, only the skin of plums and the flesh just beneath it were eaten, although some larvae tunnelled under the skin. About 12 per cent. of the dropped plums collected in late June showed evidence of damage by the larvae, and from the number of pupae found it appears that many of the larvae pupate on or within the dropped fruits. Larvae of the second generation caused relatively little injury to the fruits, and no evidence of foliage injury was found in late June or July. Preliminary observations on plots receiving three insecticidal applications at ten-day intervals beginning shortly after petal-fall for the control of the plum curculio [*Conotrachelus nenuphar*, Hbst.] showed that injury by *E. velutinana* was less severe in plots treated with parathion, acid lead arsenate, toxaphene or refined BHC (benzene hexachloride) than in those treated with technical BHC or chlordan.

Limited injury to peaches has been noticed in Ohio for several seasons. Observations indicated that it is most likely to occur where the foliage is in close contact with the fruit, since the larvae construct shelters between the two surfaces and feed within the protective webbing. Where foliage does not touch the fruit, the larvae tend to feed in the depression near the stem end of nearly mature peaches. Most of the injury to peaches was caused by the second generation. The increasing use of BHC or chlordan to control *C. nenuphar* on stone fruits and the ineffectiveness of these insecticides against *E. velutinana* suggests the possibility of increased injury to peaches and possibly other stone fruits by the latter. BHC had been applied in all the peach orchards in which injury was observed, but since these observations have been made in only one season, there is no evidence that the insect is becoming a serious problem on stone fruits in Ohio.

COX (J. A.). **Control of Cherry Fruit Flies.**—*J. econ. Ent.* **42** no. 4 pp. 702–703. Menasha, Wis., 1949.

In 1947 and 1948, several new insecticides were compared with the standard lead-arsenate treatment recommended against cherry fruit-flies, in heavily

infested isolated orchards in Pennsylvania. Emergence times were determined by the use of cloth cages put over soil that was known to contain pupae or of bait traps, containing a 2 per cent. solution of household ammonia, that were hung in the trees. Near North East, *Rhagoletis fausta*, O.-S., emerges about a week before *R. cingulata*, Lw. The adults have usually appeared in the orchards by 10th June, and if the weather is favourable at this time, the greatest number of flies will be present for about 10–14 days.

The sprays were applied from the ground outside the trees on 20th and 27th June in 1947 and on 11th and 24th June in 1948. Samples of cherries picked before the larvae began to leave the fruit were put in trays over water, and the numbers of larvae that dropped into the water were counted. All quantities of spray ingredients are per 100 U.S. gals. In 1947, 1·5 lb. fixed copper fungicide and 3 lb. hydrated lime were added to the spray mixtures, and in 1948, 2 lb. ferric dimethyldithiocarbamate was used with parathion and chlordan, and fixed copper and hydrated lime with lead arsenate and DDT. The standard spray of 2 lb. lead arsenate resulted in 0–0·29 larvae per 100 fruits ; 1 lb. 50 per cent. DDT wettable powder gave effective control (0·21–0·58 larvae) whereas 1 lb. 50 per cent. chlordan wettable powder did not (0·52–3·65). Parathion at 0·45 lb. 15 per cent. wettable powder in 1947 or 0·375 lb. 25 per cent. wettable powder in 1948 gave complete control, no maggots being recovered in either year, and left residues of 0·17 and 0·05 part per million 18 and 14 days after the last application, respectively, which did not appear to be excessive.

Iglinsky jr. (W.) & Gaines (J. C.). **Tests of Insecticides to control Red Spider Mites.**—*J. econ. Ent.* **42** no. 4 pp. 703–705, 1 ref. Menasha, Wis., 1949.

The red spider mite that infests cotton in Texas has been identified as a species of *Septanychus*, probably undescribed. Severe infestation by it developed in 1948 in cotton fields bordering pastures that had been dusted with organic insecticides for the control of grasshoppers, because the insecticides destroyed its natural enemies and the weather was favourable for it. Several dusts were therefore compared for its control. Two series of plots were laid out in the same cotton field. On one of them, which was dusted on 11th June, the control percentages reached 94·6 for sulphur, 99·1 for 1 per cent. parathion and 37·6 for 20 per cent. bis(parachlorphenoxy)methane after 75 hours, and on the other, dusted on 12th June, they reached 79 for sulphur and 96·9 and 84·1 for 0·5 and 0·25 per cent. parathion after 56 hours, but as the populations subsequently increased on both, the two areas were dusted with sulphur at 18 lb. per acre from an aeroplane on 17th June, which gave 80 and 92 per cent. reduction, respectively. In a cotton field in which the mite had increased after several applications of DDT dust, dusting with sulphur, 0·5 per cent. parathion and a dust containing 1·5 per cent. of a salt of dinitro-o-cyclohexylphenol on 21st July gave 78·1, 96·2 and 41·3 per cent. control in two days. A further application was made after a week, since the population again increased, and it was evident that control was of the same order, though precise figures were prevented by the migration of the mites from the control plots owing to the maturity of the cotton. The poor results with the dinitro dust may have been due to its poor dusting qualities, which made it difficult to obtain adequate coverage of the plants. Parathion acted more rapidly than sulphur. A fourth experiment was carried out against red spiders on groundnuts, in which sulphur applied on 4th August gave almost complete control for seven days, whereas a new generation developed after six days on plants treated with the dinitro dust. The latter gave better control on groundnuts than on cotton, probably owing to better distribution of the dust.

KULASH (W. M.). **Soil Insecticides for Control of Cutworms.**—*J. econ. Ent.* **42** no. 4 pp. 705–707. Menasha, Wis., 1949.

Observations were made in North Carolina in 1948 of the effect on larvae of *Agrotis ypsilon*, Hfn., of soil treatments with various insecticidal dusts applied in January or March and originally intended against wireworms. The dusts were applied with a power duster to soil that had not been turned after the previous crop of soy beans, and the soil was immediately harrowed to a depth of 6–7 ins. Maize was planted about nine weeks after the January treatment and 2–3 weeks after the March treatment, and cutworm damage became evident soon afterwards. In one field, January applications of a dust of enough technical BHC (benzene hexachloride) to give 1 per cent. γ isomer, at 20 and 40 lb. per acre, 5 per cent. chlordan at 40 and 100 lb., 10 per cent. DDT at 100 lb. and a mixture of 5 per cent. DDT and BHC to give 1 per cent. γ isomer at 20 lb. resulted in 41 and 68, 38 and 46, and 39 and 37 plants per 100 ft. of row on 2nd June, as compared with 33 on untreated ground, and the March treatments with the same dusts, in 74 and 77, 77 and 87, and 71 and 86, as compared with 76 for no treatment. In another field, 160 miles further south, January applications of a BHC dust (2 per cent. γ isomer) at 10 and 20 lb. per acre, 5 per cent. chlordan at 20 and 40 lb., and 50 per cent. DDT and a mixture of 5 per cent. DDT and BHC to give 0·5 per cent. γ isomer at 20 lb. resulted in 19 and 0, 1 and 19, and 53 and 39 plants per 100 ft. of row on 27th April as compared with 18 for no treatment, and March applications of BHC at the same rates, 5 per cent. chlordan at 100 and 200 lb. per acre, 50 per cent. DDT at 20 lb. and a mixture of 12·5 per cent. DDT and BHC to give 0·5 per cent. γ isomer at 40 lb. gave 123 and 109, 118 and 113, and 104 and 137, as compared with 97. In both fields, wireworms were evenly distributed and not abundant, and the relatively larger number of plants in the areas treated in March is attributed to a smaller amount of damage by the cutworm. Most damage occurred when the plants were 4 ins. high, and cold wet weather probably retarded the growth of the maize and thus prolonged its attractive stage.

Potatoes were planted in one field and harvested when mature. No undesirable qualities in them were reported, but it is considered that the use of soil insecticides cannot be generally recommended until problems arising from their employment have been more completely studied.

CALDWELL (A. H.). **Mass Rearing of *Drosophila*.**—*J. econ. Ent.* **42** no. 4 p. 707, 2 refs. Menasha, Wis., 1949.

The author describes a method for the mass rearing of adults of *Drosophila melanogaster*, Mg., for tests of insecticides. Two cakes of yeast are mixed with 5 ml. water, put in the middle of a dry paper towel that has been folded twice and treated with four drops of propylene glycol as a mould deterrent, and covered with a 9 cm. square of paper towelling wetted with one drop of propylene glycol. This assembly is placed on three paper towels that have been folded twice, placed in the bottom of a U.S. gallon jar and treated with 20 drops propylene glycol, and the paper is wetted with 85 ml. water. A screened metal lid with a double cheesecloth is used as a cover and allows any toxic gas to escape. A random sample of 75–100 three-day-old adults (which includes 35–50 females) is anaesthetised with carbon dioxide, transferred to the prepared jar, and kept at 24°C. [75·2°F.]. Oviposition begins within 24 hours, and pupation occurs in four days, the adults emerging in ten days. After pupation and before emergence, a piece of sugar-milk cake, prepared by beating together powdered whole milk, sugar and water (20 : 10 : 6) and spreading the mixture on waxed paper to a thickness of 3 mm., is placed in the jar as food for the emerging

adults. These are anaesthetised with carbon dioxide at the peak of emergence and transferred pending use to a clean jar containing sugar-milk cake and a cotton-stoppered water vial and covered with a cheesecloth lid. About 1,000–1,500 progeny are produced by 75–100 adults.

Benjamin (D. M.) & Hodson (A. C.). **A new Bait Trap Collection Record for** *Rhagoletis completa*.—*J. econ. Ent.* **42** no. 4 pp. 707–708, 1 ref. Menasha, Wis., 1949.

Rhagoletis suavis, Lw., and its variety *completa*, Cress., which the authors treat as a distinct species [*cf. R.A.E.*, A **23** 413 ; **25** 471], were collected in bait-traps in Minnesota in 1941 in the course of investigations on *R. pomonella*, Walsh. The traps were oil cans filled with a solution of 2 per cent. glycine and 3 per cent. sodium hydroxide, and three were hung in the lower branches of Thomas and Ohio black walnut trees [? *Juglans nigra*] in a small plantation at Excelsior on 20th June. They were refilled with water on 16th July, and 132 females and 56 males of *R. suavis* and 119 females and 45 males of *R. s. completa* were taken between 9th and 24th August ; three females and one male of *R. pomonella* that had migrated from a neighbouring apple orchard were also taken.

This collection represents an extension of the range of *R. s. completa* [*cf.* **23** 413] east of the 95th meridian and north-east from Lincoln, Nebraska, into Minnesota, and it is the second published record of the collection of the two forms in the same nut orchard.

Plummer (C. C.) & Shaw (J. G.). **Toxicity of DDT and Parathion Dusts to the Citrus Blackfly.**—*J. econ. Ent.* **42** no. 4 pp. 708–709, 2 refs. Menasha, Wis., 1949.

The authors review recent investigations on the control of *Aleurocanthus woglumi*, Ashby, on *Citrus* in Mexico. Field use in many parts of the country has confirmed the value of cubé in light-medium emulsive oil [*cf. R.A.E.*, A **37** 192]. Unpublished field data from Cuernavaca, Morelos, have shown the toxicity to the immature stages of sprays of 2–3 lb. 15 per cent. parathion wettable powder per 100 U.S. gals., and 1 lb. 25 per cent. parathion wettable powder with 1 U.S. quart commercial summer spreader per 100 U.S. gals. has been found highly toxic at Los Mochis, Sinaloa. In tests at Ticuman, Morelos, in 1948, sour lime trees 12–15 ft. high were dusted with 10 or 20 per cent. DDT or 1 or 2 per cent. parathion in the early morning of 26th November, at about 7 lb. dust per tree. Mean temperatures after treatment were about 66°F., and only 0·06 in. rain was recorded (on 9th December). The numbers of living first-, second- and third-instar larvae and pupae on 50 leaves picked 19 days after treatment and examined under a microscope were 0, 0, 55 and 4,154 for 20 per cent. DDT, 10, 33, 410 and 6,423 for 10 per cent. DDT, 74, 0, 0 and 10 for 2 per cent. parathion, 111, 0, 0, and 1 for 1 per cent. parathion and 1,008, 736, 2,122 and 8,124 for no treatment. The presence of living first-instar larvae on the treated leaves indicated that 10 per cent. DDT or 1 or 2 per cent. parathion did not kill all the eggs and newly hatched larvae, but the toxicity of parathion to older larvae and pupae indicates a possibility of improving present methods of controlling *A. woglumi*.

Furlong (J. R.). **Trials to determine the Value of certain new Insecticides as Preventives against Hide Beetle.**—*Bull. imp. Inst.* **45** no. 4 pp. 325–335. London [1948].

Hides and skins that are to be exported from some of the British Colonies require protection from *Dermestes maculatus*, Deg. (*vulpinus*, F.), and have

hitherto been treated by adding naphthalene to the bales or dipping the skins in arsenical solutions. Naphthalene, however, affords only partial protection, and the use of arsenicals involves risks of poisoning, while the dipped skins may develop putrefactive tainting if they are not carefully and properly redried. Preliminary tests of the protection value of DDT, BHC (benzene hexachloride) and sodium fluosilicate were accordingly made in Uganda. The insecticides were applied to the hair side of goat skins that had been dried and were ready for export, and the skins, after being redried if necessary, were packed in piles and infested with larvae and adults of *D. maculatus*, which were introduced between the skins. Some three months later, when untreated skins piled and infested at the same time showed considerable damage, the skins were examined and shipped to England, where they were examined on arrival and again after being subjected to tanning trials.

All the insecticides were applied as dusts, with diatomite as the diluent, DDT and BHC also as solutions in organic solvents and as emulsified solutions, and BHC also as a wettable powder. Crude BHC (13 per cent. γ isomer) was used in the dust and wettable powder. Examination three months after treatment showed that all the added insects had been killed by BHC at all rates of application, the lowest ones for the dust, solution, emulsion and suspension being equivalent to 1·3, 2·7, 23·7 and 5 gm. γ isomer per 100 sq. ft. of skin. DDT was applied at rates of 19 and 57 gm. per 100 sq. ft. in the emulsion, 63 and 16 gm. in the solution and 50 and 13 gm. in the dust. The first three of these rates were completely and the next two almost completely effective, but the last was considerably less so. The sodium fluosilicate gave almost complete mortality at 126 gm. per 100 sq. ft., and decreasing rates of kill at 40 and 10 gm. The various treatments did not affect the handling of the skins or their subsequent chrome tannage. All the finished leather prepared from skins treated with DDT was free from insect damage with the exception of that from skins treated with dust, in which the damage was slight. The performance of the other materials could not be assessed at this stage, since they were used on skins already damaged by insects.

BROADBENT (L.). **The Correlation of Aphid Numbers with the Spread of Leaf Roll and Rugose Mosaic in Potato Crops.**—*Ann. appl. Biol.* **37** no. 1 pp. 58–65, 2 figs., 10 refs. London, 1950.

The following is virtually the author's summary. An analysis of the results of experiments in different parts of England and Wales from 1941 to 1947 on the spread of potato leaf-roll and rugose mosaic [*R.A.E.*, A **37** 90, 366 ; **38** 230] showed that leaf-roll spread was correlated with the number of alates of *Myzus persicae*, Sulz., caught on sticky traps throughout the potato-growing season ; there was some correlation with the maximum count of *M. persicae* per 100 leaves, but this possibly results from the correlation between trapped Aphids and the number per 100 leaves. Spread of rugose mosaic (potato virus Y) was correlated to a lesser degree with number of *M. persicae*, perhaps because other Aphids are often vectors. With both diseases, higher correlations were obtained when the infected plants were dispersed among the healthy crop than when they were placed together in a row. It is concluded that it is possible to predict the average health of potato stocks in the following year from average trap data ; further work may enable the health of individual stocks to be predicted.

JOHNSON (C. G.). **A Suction Trap for small airborne Insects which automatically segregates the Catch into successive hourly Samples.**—*Ann. appl. Biol.* **37** no. 1 pp. 80–91, 1 pl., 5 figs. London, 1950.

The following is the author's summary. This paper describes the design and operation of a suction trap which takes in air at a constant rate in winds up to 12 miles per hour. The catch is deposited in a collecting tube into which closely fitting disks fall, one every hour, thus segregating the catch into successive hourly samples. The trap is electrically driven ; it operates in all weathers and heavy rain does not disorganise the catch.

EATON (J. K.) & DAVIES (R. G.). **The insecticidal Activity of some synthetic organo-phosphorus Compounds.**—*Ann. appl. Biol.* **37** no. 1 pp. 92–104, 15 refs. London, 1950.

Laboratory tests were made at East Malling by various dipping techniques of the toxicity of a series of more than 20 synthetic organo-phosphorus compounds to the overwintering eggs of *Aphis pomi*, Deg., *Operophtera brumata*, L., and *Paratetranychus pilosus*, C. & F. (*Metatetranychus ulmi*, auct.) and of the more promising of these to the summer eggs and adult females of the mite. The methods used for the insect eggs were taken from the literature [*R.A.E.*, A **33** 328, etc.] ; those for the mite are described in detail. The eggs of the mite were highly resistant to all the compounds tested, those of the moth were most susceptible to parathion (paranitrophenyl diethyl thionphosphate), and those of the Aphid to paranitrophenyl diethyl phosphate. In the tests against the summer forms of the mite, HETP (hexaethyl tetraphosphate prepared according to Schrader's method [**37** 487]) was highly toxic to the adult females at a concentration as low as 0·025 per cent., but had little effect on the eggs, which confirms the necessity for two applications against Tetranychids reported in the literature [*cf.* **36** 154]. Parathion and paranitrophenyl diethyl phosphate gave almost as good or better control of the adult females and were more effective against the summer eggs than the other materials tested, but indications were obtained in further work that, at a concentration of 0·05 per cent., they might permit sufficient eggs to hatch to enable populations to increase subsequently under favourable conditions.

From the results with eggs of *A. pomi*, it is concluded that high toxicity is not associated with unsubstituted alkyl or aryl phosphoric or thionphosphoric acids (*e.g.* triethyl phosphate), or with the presence of three similar substituted organic groups (as in tri-(paranitrophenyl) thionphosphate). The most effective compounds in the series of substituted phosphoric and thionphosphoric esters investigated all had two alkyl groups and a strongly electron-attracting substituted aryl group, and were, in order of increasing toxicity, phenyl diethyl phosphate, parachlorphenyl diethyl phosphate, parathion, paranitrophenyl diethyl phosphate and paranitrophenyl di-isopropyl phosphate (the last two being equal). The first of these gave 2·9 per cent. mortality at a concentration of 0·05 per cent. and the last two 100 per cent.

Field spraying trials in which the insecticides were used at equal concentrations showed that HETP and parathion applied during May–July were effective substitutes for nicotine against *Anuraphis padi*, L. (*Brachycaudus helichrysi*, Kalt.) on plum, *Phorodon humuli*, Schr., on hops, and *Aphis pomi* on apple. In the last case, in which counts were made at 7 and 24 days, parathion, like the other two insecticides, had ceased to be toxic in less than three weeks. Parathion appeared to be more toxic than HETP to *Coccinella septempunctata*, L., *Adalia bipunctata*, L., and Syrphid larvae preying on *Anuraphis padi*.

LORD (K. A.). **The Effect of Insecticides on Respiration. II. The Effects of a Number of Insecticides on the Oxygen Uptake of adult *Tribolium castaneum* Hbst. at 25°C.**—*Ann. appl. Biol.* **37** no. 1 pp. 105–122, 1 pl., 11 figs., 7 refs. London, 1950.

The following is virtually the author's summary of this second paper of a series [*R.A.E.*, A **37** 486]. A method is described by which non-volatile contact insecticides can be applied as dusts in a modified Barcroft respirometer with the minimum of disturbance. The technique makes it possible to observe the initial effects of insectides on insect respiration. This apparatus was used to study the effects on the respiration of adults of *Tribolium castaneum*, Hbst., of a number of insecticides, including so-called inert dusts, and other finely divided solids, some of which are used as diluents. At 80 per cent. relative humidity, talc, carborundum, Almicide (a proprictary preparation of finely divided aluminium oxide), stockalite (china clay), and decolorising charcoal caused no appreciable immediate change in the rate of oxygen uptake of *T. castaneum*, but the highly toxic substances, aluminium oxide and charcoal, had caused a marked decrease after 24 hours. At 20 per cent. relative humidity, talc caused an increase only after 48 hours, but aluminium oxide caused an almost immediate slight increase in respiration and a rapid evolution of water vapour. It is suggested that the increase in respiration may result from an increased metabolism to replace water lost through the cuticle.

DNC (dinitro-o-cresol), parathion, γ BHC (γ isomer of benzene hexachloride), DDT, pyrethrins, toxaphene, chlordan and hexaethyl tetraphosphate all caused an increase in oxygen uptake before killing *T. castaneum*, but lauryl thiocyanate did not. Toxaphene and chlordan required a much longer time to cause an increase than did any of the other substances tested. DNC in sublethal concentrations caused an increase. Concentrations of DNC giving 100 per cent. kill caused a rapid increase in oxygen uptake, of which the magnitude and duration were independent of concentration. Parathion caused an increase after a time delay that depended on the concentration used. The magnitude and duration of the increase were not greatly affected by the concentration. The effects of the concentration of γ BHC and the pyrethrins are complex and require further study. Both can affect *T. castaneum* without affecting respiration. Knockdown can occur without affecting the respiration rate.

LORD (K. A.). **The Effects of Concentration of Poison and the Amount applied on the Toxicity of insecticidal Dusts to Adult *Tribolium castaneum* Hbst.**—*Ann. appl. Biol.* **37** no. 1 pp. 123–126, 3 refs. London, 1950.

Under the experimental conditions described in a previous paper [see preceding abstract], the concentration of poison in a dust could be accurately controlled, but not the amount of dust applied to the insect. Experiments were therefore made to determine the relative importance of these factors influencing toxicity. Weighed quantities of talc dusts containing dinitro-o-cresol, benzene hexachloride or DDT at different concentrations and groups of 20 adults of *Tribolium castaneum*, Hbst., were placed in tubes, the tubes were gently shaken to coat the insects with the dust, and the insects were left in contact with the dust for 24 or 48 hours under controlled conditions of temperature and humidity. It was found that comparatively large changes in the amount of dust of a given concentration are necessary to produce appreciable differences in mortality, but small changes in the concentrations of poison in a given amount of the dust produce large differences. Tests in which parathion, lauryl thiocyanate, chlordan, toxaphene and pyrethrins were also included confirmed that in general small increases in concentration cause large increases in mortality.

Broadbent (L.) & Hull (R.). **Aphides in Root Clamps.**—*Agriculture* **54** no. 7 pp. 319–322. London, 1947.

This is an account of the results obtained in the first two years of the work in Britain already noticed from a more detailed source [*R.A.E.*, A **38** 230] showing that mangel clamps provide important overwintering sites for Aphids, particularly *Myzus persicae*, Sulz. The Aphids feed on the young shoots round the root crowns and increase by asexual reproduction throughout the winter and as long as any living mangels remain in the clamps, and the winged individuals that develop in spring fly to many types of crops. Both sugar-beet yellows and mosaic are common in mangels, and if infected roots are present in the clamps, the viruses may be spread to young mangel and beet crops by migrating *M. persicae*, their chief vector. The degree to which the overwintering Aphids are protected from the cold and the influence of the method of harvesting and clamping on the infestation are discussed [*cf. loc. cit.*].

Jones (D. P.), Petherbridge (F. R.) & Jenkins (A. C.). **Beet Carrion Beetle in England and Wales.**—*Agriculture* **54** no. 8 pp. 375–377. London, 1947.

Damage to mangels and sugar-beet by Silphids has been recorded from all parts of England. The chief and possibly the only species of economic importance in Britain is *Silpha* (*Aclypea*) *opaca*, L. *S.* (*A.*) *undata*, Müll., which frequently causes severe damage on the continent, occurs in Britain but is not known to be injurious, and records of *S.* (*Thanatophilus*) *rugosa*, L., and *S.* (*Phosphuga*) *atrata*, L., attacking field crops there lack confirmation, but a single instance of damage to beet by *S. obscura*, L., was observed in the Isle of Ely in 1940.

Both the adults and larvae of *S. opaca* are plant feeders. Among crops, the preferred food-plants are mangels and sugar-beet, but cereals, crucifers and potatoes may also be attacked. Both stages cause serious injury, though usually only the larvae are encountered. They feed on the leaves causing more or less severe defoliation, and sometimes destroy the whole crop, though a good measure of recovery may be expected from even badly defoliated plants and redrilling is rarely justified. The adults hibernate under débris, chiefly at the borders of woods, become active with the onset of fine weather in April, and feed for a time before mating and reproducing. Oviposition continues throughout May and June. The larvae hatch in a few days and feed mainly when the weather is warm and not too wet. They become full-fed in 2–3 weeks, the pupal stage lasts 10–14 days, and the new adults feed for a few weeks before seeking winter quarters. There is only one generation in the year, but, owing to the extended oviposition period, overwintered and young adults and larvae of all sizes may be present together.

S. opaca appears to have been most active on sugar-beet in the east of Norfolk, and a few cases of moderate or severe injury have been found in fenland districts devoid of woods and hedgerows, but it is generally distributed in England and Wales and severe damage to sugar-beet or mangels is liable to occur anywhere. Until recently, the best control was obtained with baits of 1 lb. Paris green or sodium fluoride and 30 lb. bran, with or without molasses or sugar, broadcast at the rate of 25–30 lb. per acre, or with a dust of Paris green and lime, but in trials in Norfolk in 1945, a 5 per cent. DDT dust applied along the rows at the rate of 34 lb. per acre gave much better control than poison baits. A dust containing about $2\frac{1}{2}$ per cent. commercial benzene hexachloride has been reported to give good control of adults and fair control of larvae, but was ineffective in Norfolk. Treatments must be applied in good time for maximum benefit and are not advisable if most of the larvae are nearly full-grown (about half an inch in length), since most of the damage will have been done.

Menzel (R.). **Bekämpfung tierischer Schädlinge mit DDT-Präparaten.** [Control of Animal Pests with DDT Preparations.]—*Schweiz. Z. Obst- u. Weinb.* **56** no. 4 pp. 70–75, 2 figs., 11 refs. Wädenswil, 1947.

Synthetic insecticides, such as DDT and Nirosan [a preparation of tetranitro carbazole], are gradually replacing arsenicals and nicotine in the control of the vine moths [*Clysiana ambiguella*, Hb., and *Polychrosis botrana*, Schiff.] in Switzerland [*cf. R.A.E.*, A **35** 145, 198], and experiments at Wädenswil and Lausanne have shown that two applications of either are usually sufficient to ensure good results. The first is directed against the larvae of the first generation and should be applied at the end of May or the beginning of June to the inflorescences, and the second, against the second generation, should be applied between the middle of July and beginning of August to the clusters of grapes. Instances of failure in individual vineyards could probably have been avoided by the co-operation of all the growers in a district. Some growers have made a practice of adding DDT to sprays against mildew and thus applying it 3–5 times in a season. Overtreatment of this type has been followed in late summer and autumn by outbreaks of the mite, *Paratetranychus pilosus*, C. & F., probably owing to the destruction of its natural enemies. Damage to these can be reduced by spraying only the grape clusters and not the whole vines.

Schneider (F.). **Die Bedeutung des Kirschenstechers (*Anthonomus rectirostris* L.) für den schweizerischen Kirschenanbau.** [The Significance of *A. rectirostris* for the Cultivation of Cherries in Switzerland.]—*Schweiz. Z. Obst- u. Weinb.* **56** pp. 370–374, 388–390, 402–404, 4 figs., 4 refs. Wädenswil, 1947.

An outbreak of *Anthonomus rectirostris*, L., occurred on cherries in Canton Graubünden, Switzerland, in 1945, and observations on its habits and the damage that it causes [*cf. R.A.E.*, A **22** 612 ; **23** 584] were carried out there in that year and in 1947. It was found that retarded maturation of the fruits is not a result of infestation, but rather a predisposing factor. The female has to puncture the fruit to the kernel in order to oviposit, and its rostrum is not long enough to reach a kernel more than 2 mm. deep, though the weevils sometimes attempt to puncture fruits up to 10 mm. in diameter. Among 200 fruits from a wild cherry-tree examined in July 1945, hardly any of the ripe ones were injured, whereas almost all the hard unripe ones had been attacked and eventually gave rise to adult weevils. The chief damage is caused by the maturation feeding of the adults on the young fruits, which sometimes leads to a complete loss of crop, and by the puncturing of the fruits for oviposition. The feeding of the larvae within the kernels causes little injury to the fruits, but further damage occurs when the adults emerge. In cultivated cherries, the weevils puncture more fruits than they lay eggs in, and thus spoil a great number of fruits.

The distribution of *A. rectirostris* in north-eastern Switzerland is discussed, and it is concluded that it occurs wherever cherries are cultivated but that various factors prevent its increase on them. Many of the adults emerge from the fruits after these have already been harvested and used and are so destroyed ; large, well cultivated orchards in the principal cherry-growing areas are usually far from the edges of woods, etc., which probably constitute the preferred winter quarters of the weevil ; and its chief food-plants are the wild *Prunus padus*, which occurs mostly in damp sites in woods and in the mountains, and wild varieties of sweet cherry (*P. avium*), which are attacked because they have long flowering and ripening periods and small fruits. Infestation of cultivated cherries was found to be in inverse proportion to the size of the

fruits ; of varieties with large fruits examined about the middle of June, the early ones, on which the fruits had almost reached their full size at the time of oviposition, were not attacked at all, and the late ones were punctured but no eggs were laid in them. Outbreaks of *A. rectirostris* in Graubünden are attributed to the presence of wild and semi-wild varieties of cherries in the mountain villages and the proximity of forests and hedges.

Blunck (H.). Ed. **Tierische Schädlinge an Nutzpflanzen. Erster Teil.** [Animal Pests of Economic Plants. Part I.]—Sorauer (P.). *Handb. Pflanzenkr.* **4,** 5. Aufl., 1. Lief., 427 pp., 220 figs., many refs. Berlin, P. Parey, 1949. Price 38 *DM.*

The animal pests of cultivated plants are the subject of the fourth and fifth volumes of Sorauer's text-book and this is the first part of a fifth edition of the fourth volume. The scope of the complete volume is to remain the same [*cf. R.A.E.*, A **13** 163], but, among the insects, the Trichoptera and Lepidoptera are to be dealt with in the second part. Many of the sections on insects and mites have been enlarged by the inclusion of further species and recent information on bionomics and control. Numerous changes in arrangement and nomenclature have been made.

Cendaña (S. M.) & Baltazar (C. R.). **A biological Study of** *Empoasca flavescens* **Fabricius (Cicadellidae, Homoptera).**—*Philipp. Agric.* **31** no. 1 pp. 1–22, 3 figs., 9 refs. Los Baños, 1947.

Empoasca flavescens, F., attacks several cultivated crops in the Philippines when it is abundant [*cf. R.A.E.*, A **23** 709], and was one of the main causes of the failure of a campaign to grow cotton in Luzon during the Japanese occupation. Detailed descriptions are given of all stages of this Jassid, with a key to the five nymphal instars. On cotton in the laboratory, the eggs were laid singly in punctures in the leaf veins, petioles or tender stems and hatched in 5–9 days. The nymphal stage lasted 5–10 days for males and 6–10 for females, and total development required 11–17 and 12–18 days, respectively ; the differences between means for the two sexes were significant. Adult males lived for 1–8 days and females for up to 36 days. Eight females collected in the field immediately after mating laid 4–11 eggs each, and several gravid females contained only 4–5 mature eggs when dissected. There appeared to be slightly more females than males in the field. In addition to cotton, the Jassid was observed on egg-plant [*Solanum melongena*], *S. mammosum* and *Hibiscus* (*Abelmoschus*) *esculentus*. The adults usually fed near the edges of the undersides of the leaves. On cotton they caused wilting and drying of the leaves, and infested plants appeared stunted and unthrifty. The other plants were less susceptible to attack ; the leaves of egg-plant and *Hibiscus* turned yellow and dry at the edges ; the former suffered severely in March and April, when the pest was most abundant, but was unaffected in rainy months. The numbers of *E. flavescens* tended to increase during the drier months and to decrease during rainy ones, being greatest during March, April and July. Nymphs were always more abundant than adults. As the Jassids prefer young plants to mature ones, excessive injury might be prevented by early planting, so that the plants reach maturity before the hot weather. Spiders of six unidentified species preyed on the nymphs and adults, and numerous examples of both were killed during very rainy weather in late August and September 1946 by a fungus identified as *Cephalosporium* sp. No other natural enemies were observed. Different varieties of egg-plant showed consistent differences in the degree of infestation, possibly owing to differences in the texture and hairiness of the

leaves, but there was no significant difference between four varieties of cotton with hairy or glabrous leaves.

In the laboratory, all nymphs and adults died within two hours of being sprayed with an emulsion of kerosene containing DDT, and in the field the same emulsion gave complete control in one day. A few leaves of the egg-plant showed injury after the application of the spray, but there was no noticeable injury when the application was not excessive and the spray broke into a fine mist. Cotton showed no spray injury. A 10 per cent. DDT dust gave complete control in one day in the field, with no injury to the plants.

Abdel-Malek (A.). **A Study of the Biology of** *Chelonella sulcata* **Nees (Hymenoptera : Braconidae).**—*Ohio J. Sci.* **47** no. 5 pp. 206–216, 9 figs., 14 refs. Columbus, Ohio, 1947.

The results are given of laboratory studies on the biology of *Chelonus* (*Chelonella*) *sulcatus*, Nees, in Egypt, where its hosts include *Platyedra gossypiella*, Saund., on cotton [*cf. R.A.E.*, A **7** 163] and *Ephestia kuehniella*, Zell. It was successfully reared in the laboratory on *Earias insulana*, Boisd., as well as *P. gossypiella*, but *Ephestia kuehniella* was used as the host in this investigation. All stages of the parasite are described. The eggs were deposited and hatched within those of the host, and the egg stage lasted 3–5 days at 20°C. [68°F.] and two days at 28°C. [82·4°F.] ; the egg stage of *Ephestia* lasts seven days at 20°C. and four days at 28°. There was no preoviposition period, and the females deposited all the mature eggs contained in their ovaries if sufficient host eggs were available. The number of eggs deposited within each host egg varies with the number of the latter available, but may be large. All the parasite larvae in one host egg hatch, but soon after the host larva hatches only one has survived. The age of the host egg did not influence oviposition or the development of the parasite within it. There was a direct relation between the rate of oviposition by the *Chelonus* female and the amount of food it consumed. Oviposition took place at temperatures of 15–40°C. [59–104°F.], and the number of eggs deposited increased as the temperature rose, though females kept at 35°C. [95°F.] died nine days earlier than those kept at 26°C. [78·8°F.]. The parasite larva spent practically all its life free within the body-cavity of the host larva. There were three larval instars ; at a constant temperature of 27°C. [80·6°F.], they lasted 16, 4 and 3 days, respectively, the last comprising one day within the host and two outside it. The parasite spun its cocoon within that of the host, which was formed a few days previously. There were six generations in the year, and the larvae of the sixth spent nearly three months in the late first-instar within the hibernating host larvae. Pupal development was retarded by exposure to a temperature of 8°C. [46·4°F.] ; 40 days was the maximum for which pupae survived at this temperature. No males were seen or reared in the laboratory, but two emerged among 100 adults from cotton bolls collected in the field. They paired with two females, but these also produced only female offspring. Adults kept without food or water, with food but no water, with water but no food and with both survived for 2–5, 6–15, 4–8 and 10–33 days, respectively, at 8–30°C. [46·4–86°F.], low temperature reducing their life.

Coaton (W. G. H.). *Cryptotermes brevis*, **a new Wood-borer Problem in South Africa.**—*Bull. Dep. Agric. S. Afr.* no. 290, 18 pp., 5 figs., 6 refs. Pretoria, 1948.

Two native and one introduced species of *Kalotermes* (*Cryptotermes*) nest in seasoned timber in South Africa. The native species are *K. havilandi*, Sjöst., which is found in northern Zululand where settlement is sparse, and

K. merwei, Fuller, which occurs in the eastern coastal belt from Zululand to Port Elizabeth. Neither has been found in buildings and it is probable that wood sheltered from precipitation is too dry for *K. merwei*. The introduced species is *K. brevis*, Wlk. ; A. Emerson, to whom specimens from South Africa were sent, has confirmed the view that *K. pseudobrevis*, Fuller [*R.A.E.*, A **9** 580] is identical with it [*cf.* **25** 16]. It is well established and injurious in buildings in Durban and Port Elizabeth and was found in a building 60 miles south of Durban in 1947, but has never been observed in wood in the open. It appeared in Durban in 1918, and its occurrence elsewhere is attributed to the transport of infested wood from that city ; it was not recorded at Port Elizabeth until 1947, but the severity of the infestations indicate that it must have been present there for 15–20 years. An account is given of its nesting and feeding habits, the forms found in a colony are briefly described, and methods of control are discussed.

K. brevis attacks the heartwood and sapwood of both hardwoods and softwoods, and a slab of Burmese teak [*Tectona grandis*], which is practically immune from native subterranean termites, was found to be riddled by its galleries. The colonies remain small, but their presence constitutes a serious menace, since the rate of reinfestation of the same piece of wood is very high, all timbers protected from precipitation are susceptible, very small pieces of wood, such as plugs, are successfully colonised, and timber taken from infested buildings is frequently used in other localities. The importance of the prompt eradication of infestations by individual owners is pointed out, and the prevention of the sale and transport of infested lumber and manufactured articles and the pretreatment of all timber for use in buildings are recommended.

A solution of 5 per cent. pentachlorphenol in white spirit with an auxiliary solvent has given excellent control of established infestations when applied as a power spray provided that the termites are in the sapwood of softwoods that it penetrates adequately [*cf.* **36** 107]. It gives only a surface coating, however, on other types of wood, including the sapwood of some softwoods, and though this may prevent reinfestation, it will not affect established colonies. It is recommended that such colonies should be treated by adding 5 per cent. orthodichlorbenzene to the solution and injecting it with a syringe into the concealed workings through the flight holes and the holes from which faecal pellets are ejected ; the fumigant action of the orthodichlorbenzene and the white spirit destroys the termites present and reinfestation is prevented by a permanent, highly toxic deposit of pentachlorphenol. Infestations in furniture and other manufactured articles, especially those constructed of heartwood, can be safely and effectively controlled by exposing the infested article to a moist-heat temperature of 130°F. for periods varying from half an hour for timber one inch thick to 4½ hours for timber three inches thick ; this treatment will not prevent reinfestation. Heavily infested structural timbers of woods in which the termites cannot be destroyed by spraying should be removed and replaced by pre-treated timber ; those not yet infested should be sprayed as a preventive measure.

LARTER (L. N. H.). **Maize Seed Storage.**—*Trop. Agriculture* **24** no. 4–6 pp. 40–44, 1 pl., 4 refs. Trinidad, 1947.

Two successive crops of maize are grown annually in many parts of Jamaica, and the intervals between them are too short for all the seed required for planting to be obtained from the preceding crop. It is therefore necessary to store seed in quantities for 5–6 months. In the early stages of development of improved varieties, stocks of seed had to be stored for a year, and this was done by drying it in the sun to a moisture content of about 12 per cent., fumigating it overnight with carbon bisulphide, airing it in the sun and storing it in airtight 55-gal.

steel drums containing a handful of naphthalene and a basin of fused calcium chloride, the latter being changed periodically until no further appreciable quantities of water were absorbed. This treatment gave effective insect control but caused 20–50 per cent. loss of viability, owing to chemical changes in the seed, which were probably accelerated by the prevailing daytime temperatures of 85–93°F. ; refrigeration equipment was not available.

During 1944, additional storage in bags had to be attempted, and the control of weevils was a serious problem. Many consignments of seed had become infested by *Calandra oryzae*, L., in the field, and this initial infestation was controlled by fumigation, but reinfestation occurred 2–4 weeks after bagging, presumably from eggs that had survived fumigation. As more effective insecticides were unobtainable, three experiments were carried out to test the effect of various readily available dusts. Selected, graded and fumigated seed was dusted in a revolving drum and bagged, and the bags were stored in stacks about 5 ft. square and 7 ft. high on dunnage. Visual examination and germination tests indicated that no damage to the seed resulted in the course of dusting.

In the first test, in which the seed had an initial moisture content of 12·7 per cent., the dusts were used at 2 oz. per 60 lb. seed, and storage continued from 19th July 1944 to 11th May 1945, during unusually dry weather, hydrated lime, ignited bauxite and Agrosan kept the population below ten weevils per bag, which was considered satisfactory ; there were 979 and 130·8 per bag at the end of the test in untreated seed and seed treated with kaolin. The second test was carried out from 26th October 1945 to 8th March 1946, during very wet weather, on seed that was moderately infested and had a moisture content of 11·7–16·8 per cent. The dusts used were hydrated lime, kaolin, Agrosan, Alkalox (calcined aluminium oxide) and a mixture of enough BHC (benzene hexachloride) with kaolin to give 0·001 per cent. γ BHC. They were applied at about 1·5–2 oz. per 100 lb., and all were ineffective, as also was treatment with 1 oz. mercury brick (a porous inert matrix impregnated with 27 per cent. mercury in droplets of 1–15 microns), broken into about 20 pieces and distributed in each 100 lb. bag. At the end of the experiment, the maize was heavily infested by fungi and in an advanced state of fermentation. The third experiment was carried out from 1st March to 10th December 1946, when the weather was slightly drier than usual and no extended wet periods occurred, on maize containing 11·7–14·5 per cent. moisture. The treatments were the same as in the previous test, with the addition of γ BHC at 0·002 per cent., and the same amounts were applied in 60 lb. seed. Alkalox, 0·002 per cent. γ BHC and mercury resulted in 0, 0 and 121·5 weevils per bag and 9·1, 3·2 and 6·5 per cent. damaged seed, and the other materials were relatively ineffective. The lower concentration of γ BHC gave effective control in the early stages, but did not prevent heavier final infestations than no treatment.

Germination tests showed no consistent relation between weevil population and loss of viability of apparently undamaged seed. The latter was more rapid in bags than in airtight drums, probably owing to the higher moisture content of the seed, and there was a clear relationship between treatment and rate of loss of viability. Under the wet conditions of the second experiment, no treatment prevented complete loss of viability. Those that prevented it most effectively were lime and Agrosan in the first and Alkalox and 0·002 per cent. γ BHC in the third.

It is concluded that the method of storage in airtight drums is satisfactory for small quantities of seed, though the store should be equipped with a refrigeration plant for larger amounts. If it is necessary to store the seed in bags, it should be treated with Alkalox or 0·002 per cent. γ BHC, and the storehouse should be well ventilated, if possible by exhaust fans, and the roof and walls designed to give a minimum internal temperature.

Brimblecombe (A. R.). **Fruit-spotting Bug as a Pest of the Macadamia or Queensland Nut.**—*Qd agric. J.* **67** pt. 4 pp. 206–211, 5 figs. Brisbane, 1948.

The commercial cultivation of macadamia nut (*Macadamia ternifolia*) for human consumption and for oil-production is increasing in Queensland, but continuity of yield depends largely on the control of insect pests. These include *Homoeosoma vagella*, Zell. [*R.A.E.*, A **35** 246], *Arotrophora ombrodelta*, Lower, and, in recent years, *Amblypelta lutescens*, Dist. All stages of this Coreid are briefly described, and a list is given of its numerous food-plants, most of which have already been noticed [*cf.* **35** 275]. It originally inhabited the rain forest areas of the central coastal region, but is now distributed throughout the eastern coastal fruit belt. Rearing experiments have shown that there are three generations a year in south-eastern Queensland. Eggs are deposited singly on the young leaves of macadamia in spring, on the young fruits in summer, and probably on both nuts and foliage in autumn. Females lay only a few eggs each day, but one laid a total of 163. In summer, the eggs hatch in 6–7 days, and the five nymphal instars are usually completed in 4–5 weeks. Adults have survived for up to 54 days in summer, and those of the autumn generation overwinter and oviposit in spring.

Both adults and nymphs feed on the young shoots and the nuts ; they are active, and readily seek shelter if disturbed. As a result of the feeding of the bugs, the young shoots wilt and die, and the nuts suffer damage that varies with their age. Young nuts attacked while the shell is still soft fall prematurely and the kernel shrivels ; the feeding puncture remains visible on the shell as a watery-white spot and, if the shell has not hardened, the tissue surrounding it may collapse, shrink and split. If the nuts are attacked when the shell is beginning to harden, only small depressions develop, or they may appear undamaged, and the kernels are not entirely destroyed, though rendered unmarketable. The premature falling of the nuts is often the first indication of infestation. Since as few as 10–12 bugs per tree can destroy the crop and only one can cause the death of a shoot, it is concluded that a strong toxin is injected into the tissues during feeding [*cf.* **35** 276].

DDT sprays are used against *A. lutescens* on banana and papaya and should also control it on macadamia. They are applied to it before or during the flowering period to prevent attack by *H. vagella*, and if they were directed all over the tree, they would destroy the bugs on the shoots and might prevent further attack unless it was due to migration from neighbouring food-plants. If nuts fall prematurely and typical damage is observed on them, the trees should be sprayed with 0·2 per cent. DDT and the treatment repeated after a fortnight. If alternative food-plants in the vicinity are infested, they should be destroyed or similarly sprayed with DDT.

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